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FIRST REVIEW: COMPAQ 386

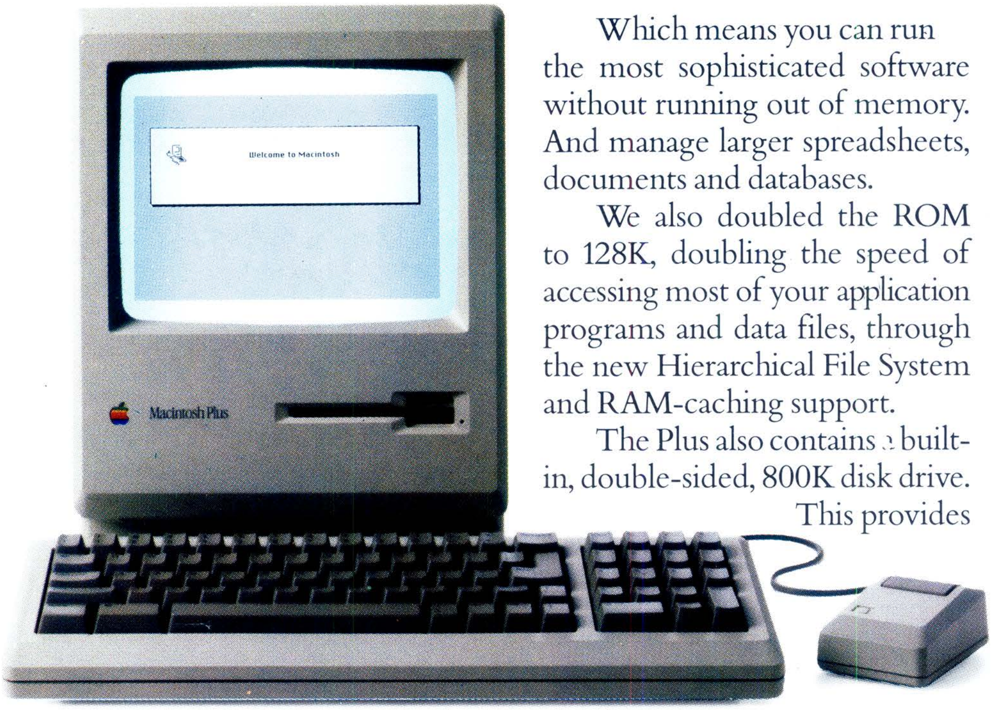
NOVEMBER 1986 $3.50

AUSTRALIA'S TOP SELLING COMPUTER MAGAZINE

AMSTRAD'S PC BOMBSHELL

Exclusive Benchtest of the 1512

New Macintosh Plus. We've added



This year Apple introduces a new Macintosh.

Macintosh Plus.

As the name suggests, it's evolutionary, rather than revolutionary

(It's not our policy to bring out totally new computers for the sake of it. Instead we strive to perfect existing ones.)

Macintosh Plus is as simple to learn and use as before.

But there are some big differences, encouraged, we don't mind admitting, by current Macintosh owners.

Some of you asked for more power, others speed. Some needed greater storage capacity, others expandability.

Some heavy number-crunchers wanted a numeric key pad and conventional cursor keys built into the keyboard rather than remote.

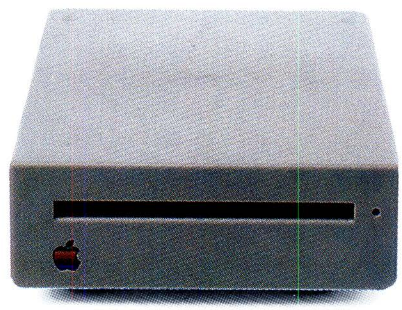
Done. Done. And done.

The pluses of this new Macintosh include a full megabyte of RAM (expandable to four megabytes).

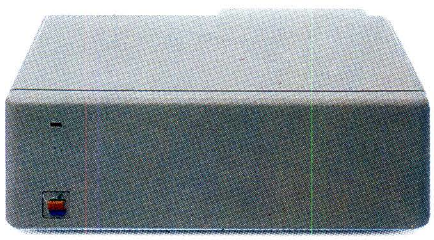
Which means you can run the most sophisticated software without running out of memory. And manage larger spreadsheets, documents and databases.

We also doubled the ROM to 128K, doubling the speed of accessing most of your application programs and data files, through the new Hierarchical File System and RAM-caching support.

The Plus also contains a built-in, double-sided, 800K disk drive. This provides twice the capacity of the previous Macintosh and the equivalent of 400 typed pages, or a bulging file drawer.



If that's still not enough, you can always plug in another 800K external drive.



Or you can really go all out and add our new Hard Disk 20.

(Its 20 megabytes are about 10,000 pages worth.)

Just plug in a Macintosh Hard Disk 20 and you can keep all your software, files, worksheets and documents within a moment's notice of your screen.

Add the Apple program Switcher, and you can actually work with several applications at once, moving information from one into another with the greatest of ease.

So you can transfer notes from an outline to a report – or numbers from a data file to a spreadsheet – as fast as you can click your mouse.

AppleCare.

All Apple products come with an automatic 3-month warranty covering all parts and labour.

But this year, Apple introduced a sort of "Warranty Plus" through the AppleCare service programme.

If you fill out and mail to us the registration form enclosed with your equipment, you will receive nine extra months' cover on top of the normal three.

Macintosh Plus also features a new SCSI connection port (dubbed "Scuzzy" in typical fashion by the development team).

SCSI stands for Small Computer Systems Interface and it's an industry standard.

We've virtually opened up the architecture. But what we've really done, of course, is open up a whole new world of possibilities.

The Scuzzy port let's you daisy-chain up to seven high-performance (and often low-priced) peripherals like hard disks, file servers and tape backups from all sorts of third parties.

Given all this power, it made sense to team it with equally impressive printers.

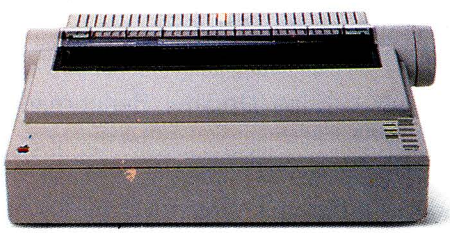
The new LaserWriter Plus is just such, producing documents with text and graphics of publishing quality.

everything except complications.

And it maintains this fidelity on copy paper, letterhead, labels, envelopes or overhead transparencies.

LaserWriter Plus has 35 different typefaces built in, a choice that would embarrass your local printer (and his invoices).

But if you don't need publication-quality printing, you can have near letter-quality by teaming up your Macintosh with the ImageWriter II.



It prints in three different modes: high-quality, standard and draft. And churns it out at speeds of up to 2½ pages per minute.

You can feed in single sheets automatically with the optional SheetFeeder.

And print up to seven colours using appropriate software.

ImageWriter II can also be shared with other Macintosh users via AppleTalk.

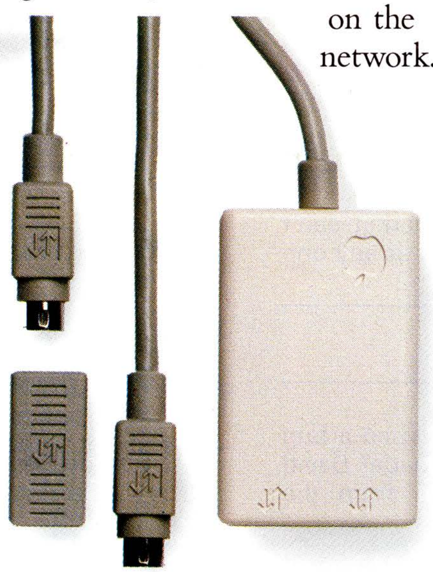
But this Macintosh isn't called Plus for nothing. You can just add and add.

Items like an AppleTalk Personal Network.

It's the most flexible, low-cost, easy-to-set-up, easy-to-use network around.

It'll connect up an office full of Macintoshes, LaserWriters, ImageWriters and file and disk servers – 32 devices in all.

Using an electronic mail package, you can send messages to any Macintosh screen on the network.



Or with EtherMac software you can share information with other computers. (Our computer is so friendly it'll even talk to IBMs.)

Add an Apple Modem 1200 to your Macintosh and you can talk to anyone virtually anywhere.

With a communications program like MacTerminal, a standard telephone and an Apple modem, your Macintosh can plug into electronic information services like Viatel, Minerva and Midas and communicate with mainframes and minicomputers.

If you already own a Macintosh, there's another plus.

You can upgrade your machine to the new one megabyte. Ask your dealer for upgrade details.

You can also upgrade your LaserWriter to become a LaserWriter Plus.

Get hands-on with the new Macintosh Plus.

You should like it.

You helped design it.

The Apple business card.

If you wish to own a Macintosh system, you can take advantage of the Apple Credit Card, available from participating dealers.

You can use it to purchase computers, peripheral equipment and software with no down-payment and less impact on your cash flow.

If you qualify, in most cases you can take your own Macintosh with you and dive straight into work with it the same day.

For an authorised Apple dealer near you outside Sydney, you call toll-free (008) 22 1555 or Sydney 908 9088.

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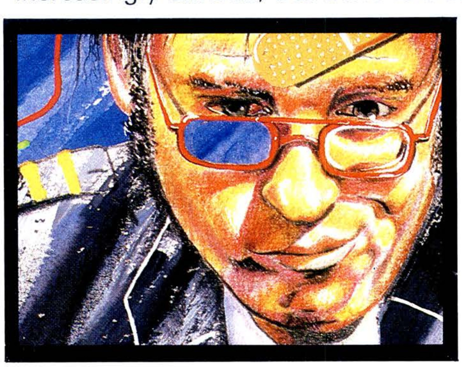
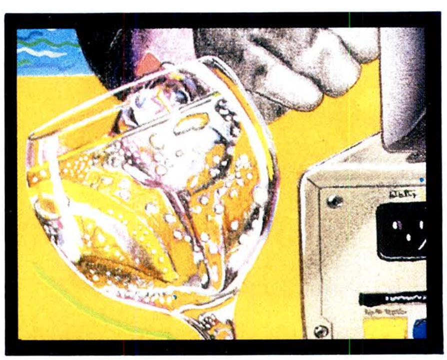
Volume 7, Number 11, November 1986

REGULARS

ChipChat returns next month.





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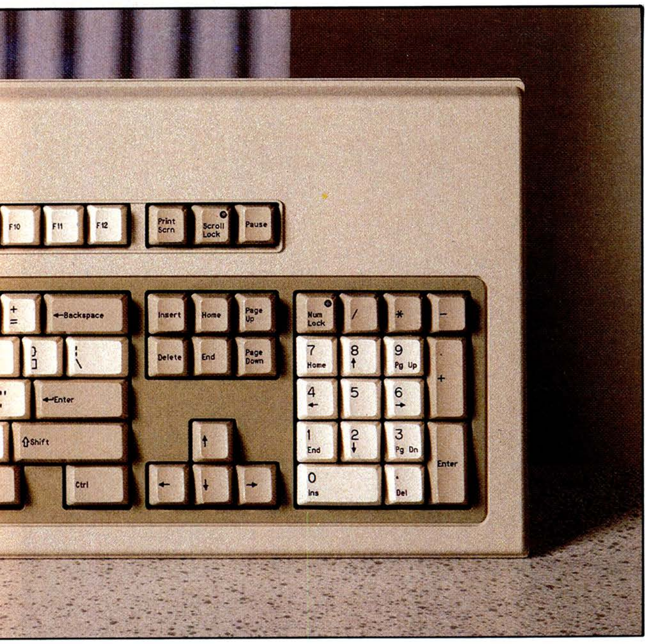

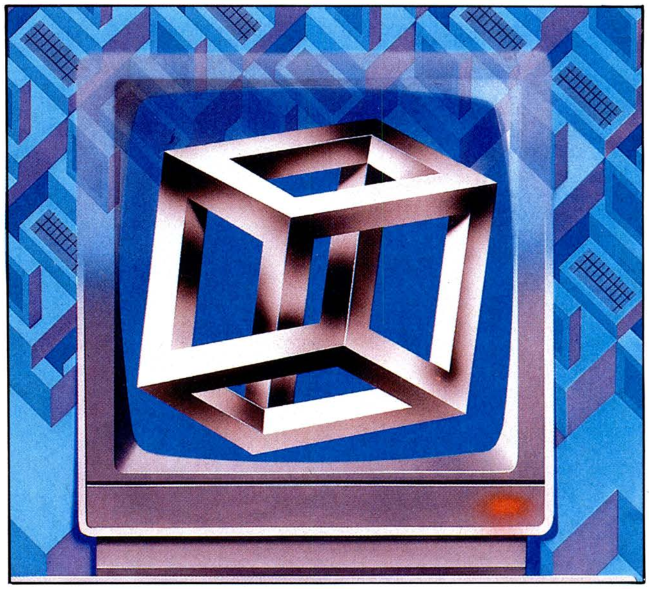

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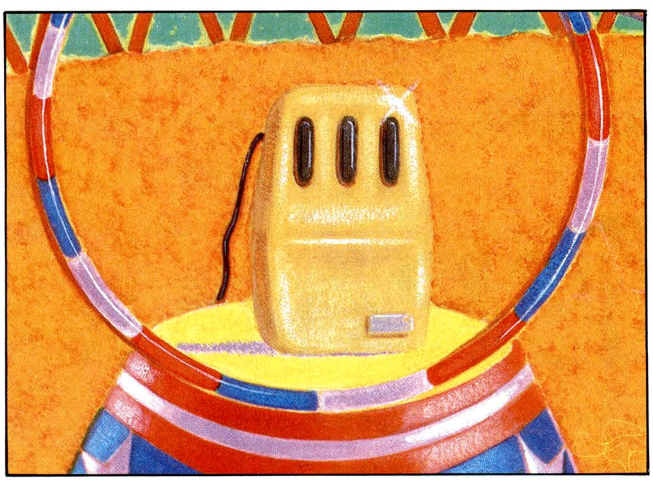

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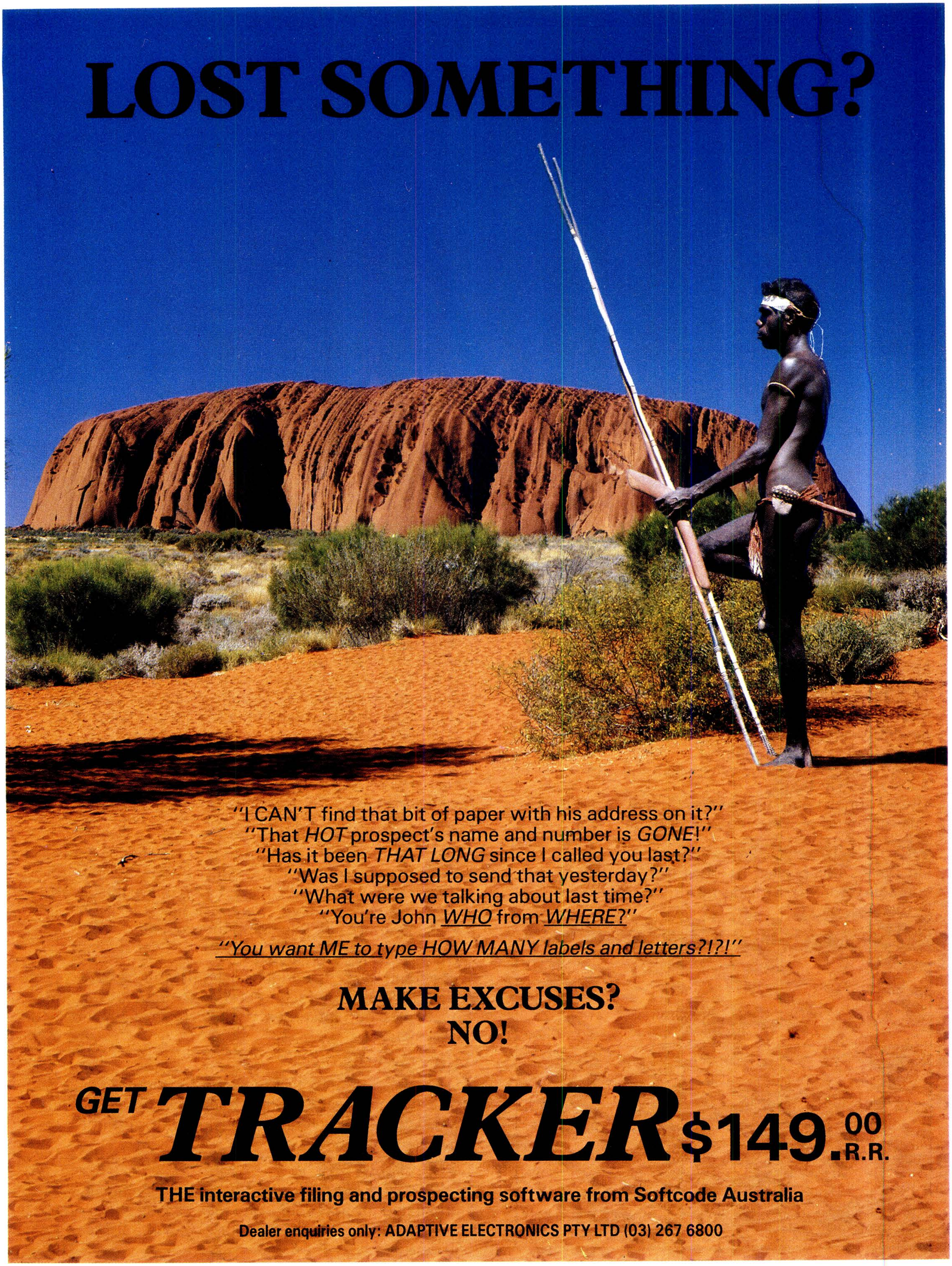

LOST SOMETHING?
"I CAN'T find that bit of paper with his address on it?"
"That HOT prospect's name and number is GONE!"
"Has it been THAT LONG since I called you last?"
"Was I supposed to send that yesterday?"
"What were we talking about last time?"
"You're John WHO from WHERE?"
"You want ME to type HOW MANY labels and letters?!?!"
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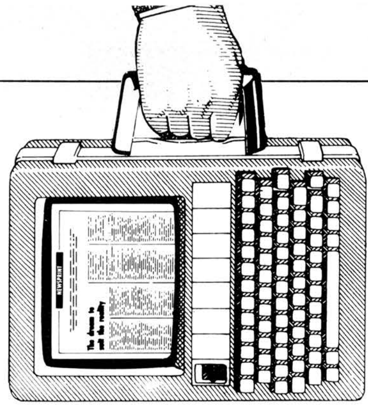

NEWSPRINT

In this month's news round-up Guy Kewney looks at how compatible the new Amstrad really is and sounds the red alert for home users.

Amstrad clarification

In my Benchtest of Amstrad's new PC published in this issue I state that an EGA card will not work with the machine. Well, the good news is that, after all, it is possible to plug an Enhanced Graphics Adaptor card (EGA) into the Amstrad PC. The bad news: there are going to be more video applications which fail on that machine, than at first I realised.

Careless, I suppose, to have suggested that 'the EGA card will not work with the Amstrad PC' when, in point of fact, it will. More precisely, then: the EGA card, which provides more colours on an IBM display, and has the option of switching across into a very high resolution with certain animation abilities on a high-scan rate screen, will only work in its 'monochrome' low-resolution mode on the Amstrad.

In this form, it is pretty well indistinguishable from the standard Amstrad PC colour display.

With a logic which I now recognise to have been flawed, I reasoned that since nobody would plug-in $1200 worth of hardware to achieve a display resolution identical to the display resolution already there, this aspect was discountable.

Wrong! The deviousness of computer users is legendary. By plugging an EGA card into a standard PC and then attaching costly extra circuitry, it's possible to construct a system of integrated computer display and video (moving pictures).

For someone who uses this system, the fact that the EGA card actually does work, even if in low-resolution mode, is crucial.

I have this information, not because I diligently obtained the address of every EGA supplier and questioned them closely about possible add-ons, and then plugged these into an Amstrad; but because a friend rang me up and quite understandably described me as a turkey. Basing his opinions on an advance copy of my review of the machine, he had made firm recommendations to a client that they buy another type of PC. 'Nonsense', they said, 'we're buying 20. The card works just fine . . .'

The news on the video front generally, however, is not all good.

The chips inside the PC 1512 imitate the function of the chips inside the IBM PC — but they achieve the effects by different means.

The IBM video display is controlled by a chip called the 6845, which has several registers, and dividers. It keeps track of where on the screen each character is, and constructs the shape of them as the video signal flashes back and forth, scanning down the screen.

Normally, these registers are fed with a few, standard numbers, which are used to switch between 40 and 80-column mode, or into display resolutions. The Amstrad can do these standard things, using a different technique, involving logic gates which do these modes and no others.

On the PC itself, there are programs which can also feed sily numbers into the 6845 registers, producing odd video effects. On the PC 1512, these programs will produce no result, because there are no such registers.

The phenomenon is documented. Amstrad has suggested to software developers that they use it to 'cripple' expensive software, so that it will not work on the standard PC. What they do (the Amstrad version of SideKick was going to be one of these) is to write those stupid numbers into the 6845 registers.
If the machine is an Amstrad, there are no registers and nothing happens. If it is a genuine PC, however, the video gets scrambled and the program ceases to be usable.

So, the software company can sell more expensive programs to the rich people who bought full-priced machines while the plebs who buy Amstrads can be satisfied with the same program at half the price.

Time will tell whether the idea is a clever one.

The effect of writing into the 6845 registers, however, is not one which is known only to copy protection obsessives. There are video toolboxes, which use the 6845 deliberately to create interesting effects. And any program which uses these effects will fail on the Amstrad.

The plus side of the bargain is that the numbers have to be chosen with care. It is (I am assured) quite possible to feed data into the 6845 registers which will actually cause the display monitor to burn up, as it in vain tries to lock onto a scan pattern outside its frequency range. And this cannot happen on the Amstrad.
Guy Kewney

A doctor for the family

I have recovered an IBM disk on which there was not one particle of information left on the outside track, track zero. In doing so, I found Norton's Utilities, which everyone swears you can't live without, and I found them to be useless in dealing with the problem. But the disk *has* been recovered.

Although the achievement was Carl Phillips', not my own, it *is* an achievement. It is also a confession of incredible stupidity, because it takes quite a lot of that to format track zero (on which all directory information is held) on an IBM disk.

To my amazement, however, any disk which has a damaged track zero is a disk which Norton's Utilities (bow down, scrape) will not look at.

Carl Phillips (see his Smalltalk V Screentest this issue) is one of those wandering programmers who knows more about the insides of the PC and family than the designers do, and he has met the problem before. His utilities don't read the disk as if it were a PC disk, but as if it were a

piece of magnetic-coated plastic.

On an IBM disk, you look for a file by going to the index — track zero. It tells you what tracks and sectors the file covers. Norton's copes with errors in the index, or deletions in the index — a file which has been erased is still there, and if you look at the index, you will find that it still knows where it is, but pretends that it has gone. You tell it to pretend it hasn't gone.

But without track zero, Norton's simply won't work! Given the reputation of Norton's I found this hard to believe — a bit like going to a medical specialist, cash in hand, and being greeted with: 'But you're ill I can't cure you if you're ill!'

I found several other utilities to suffer from the same disastrous short-coming.

But Carl's utility shows the data on each sector in hex, with an ASCII dump in parallel. You look on your disk, laboriously, until you find your file, and then you note which physical sectors it covers. When you think you have them all, you tell another Phillips utility what they are. It creates a new file, on any disk you like, with those sectors collected together, in the order you specify, and bang! You're fixed.

Meanwhile, don't put your favourite diskette into the floppy disk of an AT and type 'format'. The story of how I came to do that is long, shaming, and frankly, so incredible that I myself don't really believe I did it. But that's how I lost track zero.

Anyone needing to contact Carl Phillips should drop *APC* a note, and we'll forward it to him.

Guy Kewney

Japan powers in

As if it weren't bad enough that the US is losing the lead in semiconductor sales, the industry now has a new worry: Japan may end up controlling the market for the silicon wafers from which chips are made. Siltec is the object of a proposed $US30 million takeover by Japan's Mitsubishi Metal. Monsanto Electronics Materials, the other US wafer supplier, may also be on the block, according to Daniel Rose, a Los Altos consultant and publisher of *Electronic Materials Report*. Monsanto denies the subsidiary is for sale, even though it racked up losses totalling $US80 million in the past 18 months.

In addition, the Japanese have been buying into US producers of polysilicon, the raw material for wafers, and they already control two-thirds of the market for the materials used in packaging integrated circuits. Should US companies become dependent on foreign sources for all these building block materials, Rose warns, US chipmakers "will lose a lot of leverage over quality, prices, and technology."

When is WordStar not WordStar?

There is a 'special' (cheap) version of WordStar, WordStar 1512, especially for buyers of low-cost IBM clones like the Amstrad PC 1512.

Don't believe everything you hear about it. WordStar is not a subject where reviewers are capable of objective statements. And, specifically, don't fall into the trap of believing that, just because it says 'WordStar' on the label, you are getting WordStar in the box.

And, to save you reading all the way through this before getting it, I would add one piece of advice: don't buy WordStar 1512 if

INTRODUCING THE A★STAR II™

We're having a party! It's a going away party. And, it's for IBM. But, shhhhh! Don't tell them. We want it to be a surprise!

Why a party? Well, it's because we've been told that more than a few of IBM's customers have been "going away" ever since we introduced our A★Star™ PC/AT compatible microcomputer. Now that we've announced our new A★Star II, we figure a lot *more* of their customers will be going away. That's because the A★Star II is the *only* "network ready" PC/AT compatible that can operate at 6, 8, 10 *and* 12 MHz. And because it's now available locally in a super selection of low-cost models.

The A★Star II is not just another clone, it's better...*much* better! Not only is it faster and more powerful than IBM's model, it's also incredibly less expensive. Better yet, the A★Star II is built and backed by Wells American - a company that's been making microcomputers *longer* than IBM. (We bet that surprises even you!) But more than just an AT compatible, the A★Star II is both a single *and* a multiuser system. Each unit is factory equipped for network operation with up to 254 other A★Star, IBM or compatible computers!

If you'd like to be a part of our IBM going away party, clip and return the coupon or call us at one of the numbers below. But don't tell IBM! If they find out how many of their customers are going away, they might just go away themselves! Of course, that would be okay with us. We never *really* invited them anyway!

A 6, 8,10 *AND* 12 MHz AT?
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☐ Sounds like a terrific party! Please send me the name of my local dealer.
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SCREENTEST

TAS Plus

TAS Plus is a sub-$150 system for the IBM PC/XT and AT which offers simple data entry and reporting together with powerful programming tools. Kathy Lang considers it excellent value for money.

A superficial survey of the micro scene this year would show a wave of price-cutting among software as well as hardware suppliers. A closer look would show that several suppliers have been beavering away doing their bit to get software prices down. Among the pioneers have been the proponents of Shareware in the US, those aggressive marketeers Borland, and — the company behind this month's database review, Business Tools Inc.

Among those crying 'Who?' there will doubtless be some of the many readers of this column who have, over the past few months, asked eagerly when I would be reviewing a package called TAS Plus. This product, distributed in this country by CPS Systems in South Australia, has been released at a price which seemed at first so low ($199) that many people were anxious to know what the catch was. Well, the perfect database system has yet to be written — indeed, since there is an infinite variety both of applications and of users, I don't see how it can ever be — but my initial conclusion is that TAS Plus has remarkably few failings for what seems at the moment a remarkably cheap price.

TAS Plus is distributed for the IBM PC/XT and AT, in two versions: the basic release, at $199, provides a wide range of data management facilities, including the ability to get started just by defining the fields in your file and using default formats for screen display and reporting. It also gives you the use of much more sophisticated features, including screen printing, a powerful programming language including the ability to handle one-dimensional arrays and overlays, and an internal editor for modifying and building programs. Once built, these programs are compiled into intermediate code, which makes for fast processing (though the extent to which most database applications are disk-bound makes this less important than you might think). And for those building tailored systems, this code can be run without the source language being present, so tailored systems can be distributed without the user being able to tamper with the initial system.

To run TAS programs you need parts of TAS Plus, but although these are not supplied separately as a run-time system, substantial quantity discounts are available on the basic $199 price for those wishing to sell on copies of their programs. And for the system developer who needs still more features, there is a Developer's Version of TAS. This includes a range of system tools as well as the source code of several TAS modules written in TAS, such as the screen editor for entering and amending TAS programs, and costs $569 for a single user version and $869 for a multi-user version.

TAS needs 384k memory and two floppy drives to run on an IBM PC; where your data will fit on one floppy disk, it would be quite practicable to run TAS from a twin-floppy system. If you have more grandiose needs, there is a multi-user version of TAS with simple record and file locking. This runs on a variety of networks on IBM systems, and costs $869 including the Developer's Version. An earlier version of TAS, with essentially the same functionality though with a less gee-whiz user image and costing $569, runs on other MS-DOS systems, under CP/M and CDOS, and on several implementations of networking in those environments.

Constraints

The major features and constraints of TAS Plus are shown in Fig 1, and the main menu screen through which the facilities are provided by TAS itself (as distinct from a tailored system built with TAS) in Fig 2. The range of data types includes time as well as date, with arithmetic working correctly on both types of field; any field that is not a key field can be a (one-dimensional) array, making it relatively easy to store list data such as a person's leisure interests or languages spoken.

Numeric fields are stored in binary, thus halving the amount of storage they need compared with character storage, but in TAS Plus having the odd side effect that, if a number may take negative values, it must be defined as having an odd number of digits, in order to leave room to store the sign.

Data validation is not a strong point in TAS Plus — apart from checking that the data conforms to its defined type, about the only other built-in provision is the ability to define a mask which enumerates the values a variable may take, such as Y and N for a Yes/No field. You can, though, embed validation rules within the program that defines the screen layout for data entry.

The constraints shown first in Fig 1 are those for TAS Plus itself; those following the slash are for the Developer's Version. Several of the limits, for instance on

Now you've got one, what are you going to do with it?

Building a computer system that will do exactly what you want, is not as easy as you may have been lead to believe. At Roland, our years of experience talking to computer clients has proved that the average purchaser doesn't buy a custom made computer, they build features into them, by adding on software and hardware products that provide the best possible results.

By determining the best options you will need, Roland has taken out the problems of upgrading and replaced them with packaged solutions, that work.

Whether you are considering the purchase of a computer or you wish to expand your current model, now is the time to see Roland for both hardware and software package solutions. With a full range of options and sound advice based on your immediate and long term needs, Roland has the solutions.

- If you are looking for color on the IBM PC/XT/AT, Roland's EGA-KIT offers you 100% compatibility with IBM's Enhanced Graphics Adaptor produced on Roland's High Resolution CD 240 RGB color monitor, using STB's EGA-EXTRA.
- Roland provides the ultimate monochrome solution for word processing, spreadsheet and graphics utilising STB's Chauffeur HT and Roland's MB 142 14" Black and White monitor, providing an absolute minimum of eye strain.
- Lacking memory ... and feel like a few extra ports? Then Roland's STB memory and communication boards provide the perfect solution.
- Enhance your business graphics with Windows Draw or upgrade to Computer Aided Drawing. Roland's CAD-KIT provides both the CAD software with In•a•Vision, plus the hardware that gives you the ultimate hard copy output solution, Roland Plotters.

Your Roland package solutions are only a telephone call away, or fill in the coupon that will enable Roland to mail you the appropriate technical information.

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text, however, is kept on a different disk.

If you count carefully, you will realise that this involves one more disk than you get on a single-disk machine.

MicroPro's solution is to create a RAM-disk, and keep the text in that. It makes editing faster, they say.

Am I the only person in the world who thinks the company is mad?

Guy Kewney

Electron-beam chipmakers move out of the lab

American semiconductor companies are starting to plunk down megabucks for commercial equipment that can turn out so-called submicron chips. These integrated circuits have such infinitesimal lines — much thinner than 1 micron, which is about one-hundreth the size of a human hair — that they could not be made outside the laboratory until now. In late September, Motorola took delivery of the first commercial electron-beam system, made by Perkin-Elmer. At least four other US companies, plus a European startup, have also ordered the $US3 million machine, which can produce circuit lines down to an ultra tiny¼ ¼ micron.

Motorola wants the E-beam system mainly for half-micron, very-high-speed chips for the US Defence Dept. But it will continue to work on other submicron methods because the output of E-beams may be too low for commercial applications. While an E-beam machine traces circuits one line at a time, techniques such as X-ray lithography would photographically print images covering entire sections of a silicon wafer. Perkin-Elmer, however, claims that the E-beam approach can boost the yield of good chips. In addition, the system can easily make different chips on the same wafer — the reason European Silicon Structures, in Munich, wants one to turn out custom chips.

Evading the issue

Still-puzzled Atari tells me that it 'surprised visitors' to a recent PC Show by announcing the two machines we've been predicting for the past six months — the 2080 STF and the 4160 STF.

Actually, Atari president Sam Tramiel did surprise people when he announced the 'blit' chip, the piece of silicon which was supposed to make the Atari ST look as good as an Amiga.

A blitter moves patterns around in memory. If the memory is onscreen, you get high-speed animation.

The surprise was: a) that it was a lot slower than we thought, multiplying animation sequences around three to six times; and b) that it was only a blitter, without any of the logical operations that make the Amiga's blitter so powerful. Oh, and the other surprise was that you can, after all, plug it into existing machines, despite the firm assurances of Sig Hartmann earlier in the year that you couldn't.

In for the long term

Among the limitations of traditional disk drives is that they can work only as fast as a mechanical arm can move back and forth to retrieve information. One alternative — the so-called RAM disk, which stores information on random access memory chips — has always fallen short because of high costs, relatively small storage capacities, and the danger of losing information if power is lost. But now US tape-drive supplier Santa Clara Systems may have solved the problem.

For $US7,000 its new BATRAM system can move data six times as fast as a hard disk, while storing as much as or more than most disk storage systems for microcomputers. BATRAM uses RAM chips to hold information, and it has a two-week battery to protect stored data in case of a power failure. Thomas Quinn, the company's president says that BATRAM will boost the data processing speeds of local area networks and IBM PCs. BATRAM's price tag is stiff compared with $US1,000 or less for competitive hard disk drives. But Quinn says falling memory-chip prices will make BATRAM competitive by 1988.

Coming in from the cold

No argument, no dispute, no doubts: dBase from Ashton-Tate is a boring product. Boring, but important — and its arrival as a database manager on the Macintosh is doubly so.

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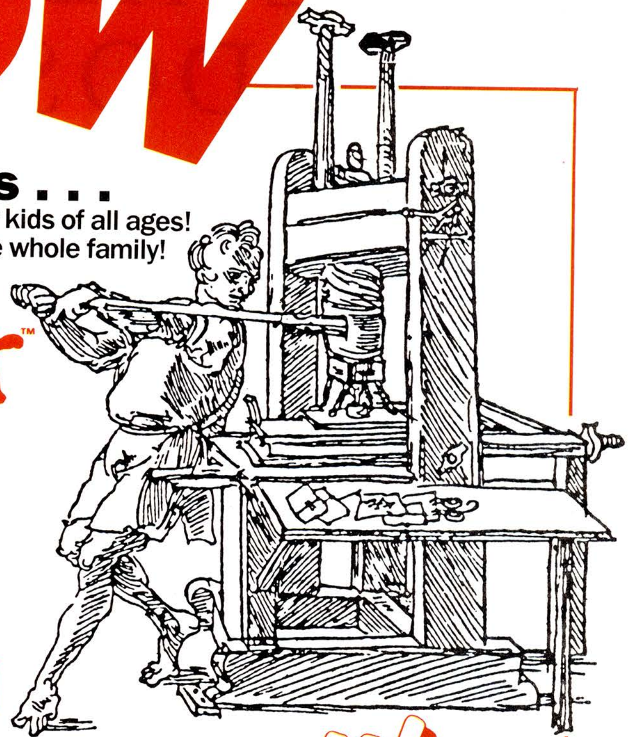

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and more.

THE ADVANTAGE OF MS-DOS* COMPUTER

The more powerful a computer, the more it seems to be deskbound.

Not so with the new Microbee/Mitac Portable PC.

Unlike most MS-DOS computers, you don't need a physique like Charles Atlas to move it from one place to the other.

It weighs in at barely 4.9 kilos.

And, by virtue of a handle, it's also easy to carry.

The keyboard and 5¼" disk drive are ingeniously incorporated into one unit, with up to 640K of RAM.

So, whenever you need to take your Microbee/Mitac Portable PC somewhere, all you need is a free hand.

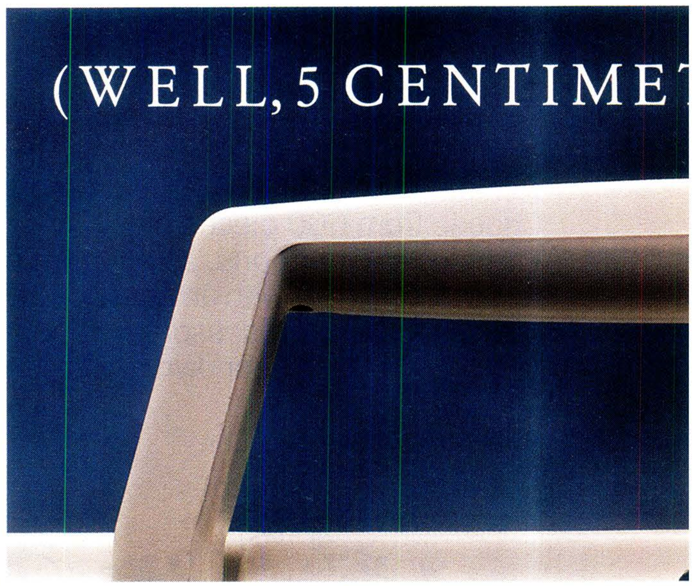
IT'S COMPATIBLE WITH YOU KNOW WHO.

This new computer opens out to Microbee users the range of IBM† PC compatible software.

The Portable PC uses the internationally accepted Phoenix BIOS.

So, unlike some compatibles, this one is truly compatible.

It also runs on the 3.1 version of MS-DOS, with all the latest additions and enhancements, plus provisions for networking.



EXPANDABLE STORAGE, OF COURSE.

The inbuilt floppy drive can store 360K bytes per diskette.

If that's not enough, however, an optional second 360K byte floppy drive can plug straight into the rear of the case.

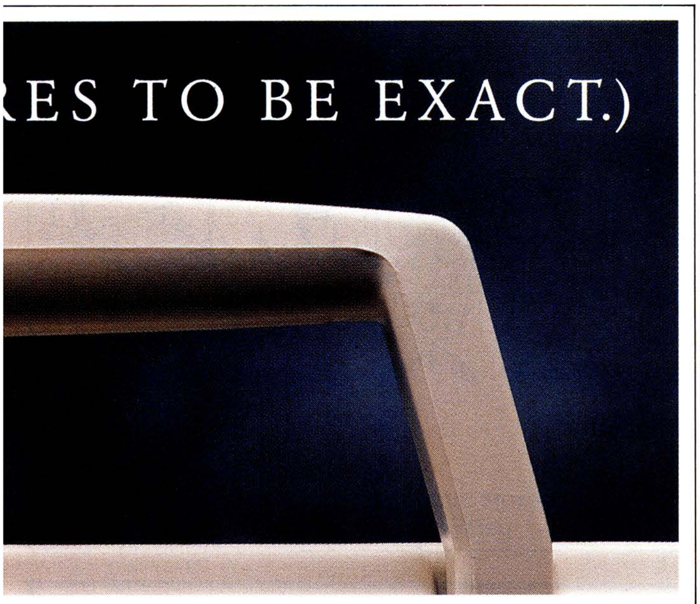
Of course, this isn't essential but it makes for far more convenient

THE NEW MICROBEE STICKS OUT A MILE.

disk-copying.

It also enables you to run large programmes which require access to expansive data files.

You can also add a 20 Megabyte



hard disk drive when you require large volumes of external storage.

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If you already own a Microbee green or amber monochrome monitor, you'll be pleased to hear that it will plug straight in.

But if you desire something a little more impressive, our new computer has a colour graphics adaptor built in as standard.

STANDARD ITEMS AND PERIPHERALS.

The Microbee/Mitac Portable PC also includes 2 serial communication ports (not just the one) plus a parallel printer port as standard.

Other standard features include a real-time clock and calendar, with a battery pack.

You'll also find that it's compatible with the range of Microbee peripherals.

So, no matter what use you have for a personal computer, the new Microbee/Mitac Portable PC can (dare we say it) handle it.

Microbee/Mitac Portable PC with 256K RAM — $1,295 (Monitor not included.)

For more information ring one of the numbers listed below.

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dBase are described as 'relational databases' in the publicity, what they really are is 'programming languages' specially designed for orthodox file handling.

For all its faults, the dBase programming language has become embedded in computer society, and users of the Macintosh have been, till now, outcasts from that part of society.

John Sculley, ex-Pepsico boss of Apple, added his few words to Ashton-Tate's announcement of the new product which *APC* will be reviewing in depth in the very near future.

Sculley said: 'Its procedural language could open the door to the development of a broad range of new applications by third parties.'

He means programmers. People who have learned dBase language should be able to take on work for Macintosh owners, now. At least, that will be the official position.

Just how compatible it is, however, will be a matter for long-term consideration. Ashton-Tate says that 'dBase Mac directly accesses IBM-compatible dBase data files.' Well, just about every database and programming language in the world can do that. What they can't do is run dBase command files.

The new version obviously is changed from IBM versions. It cannot be otherwise: put any program on the Mac, and the very nature of the computer alters the way the code looks. Impossible things become not only possible, but necessary. Large blocks of code become pointless. It may be (conceivably) that dBase programmers will find it too changed to feel at home. On the other hand, it may also be that this product is a vindication of Sculley's determination to get the Mac Plus out.

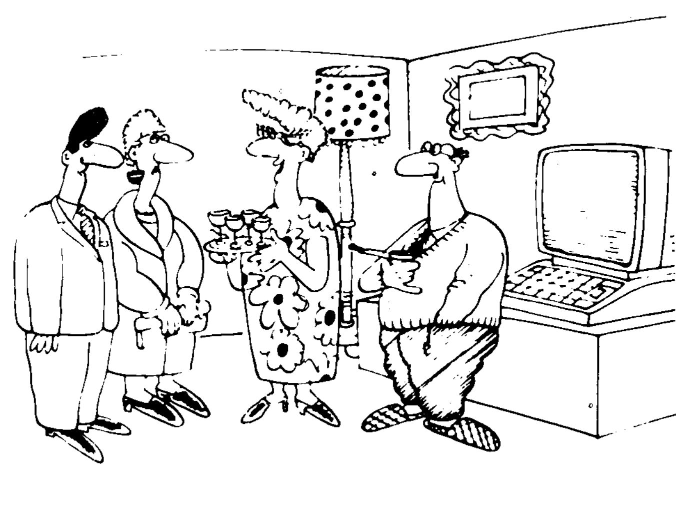
You do need a Mac Plus for this one — or at the very least, the 800k diskette drive that arrived with the Plus.

Guy Kewney

Desktop publishing: Steve Jobs is seeing it differently now

Apple Computer gave birth to personal computer desktop publishing in January, 1985, when it introduced its Laser-Writer printer. This gave the Mac a unique edge, said Apple founder Steve P. Jobs at the time, because it could do "something no other personal computer can do."

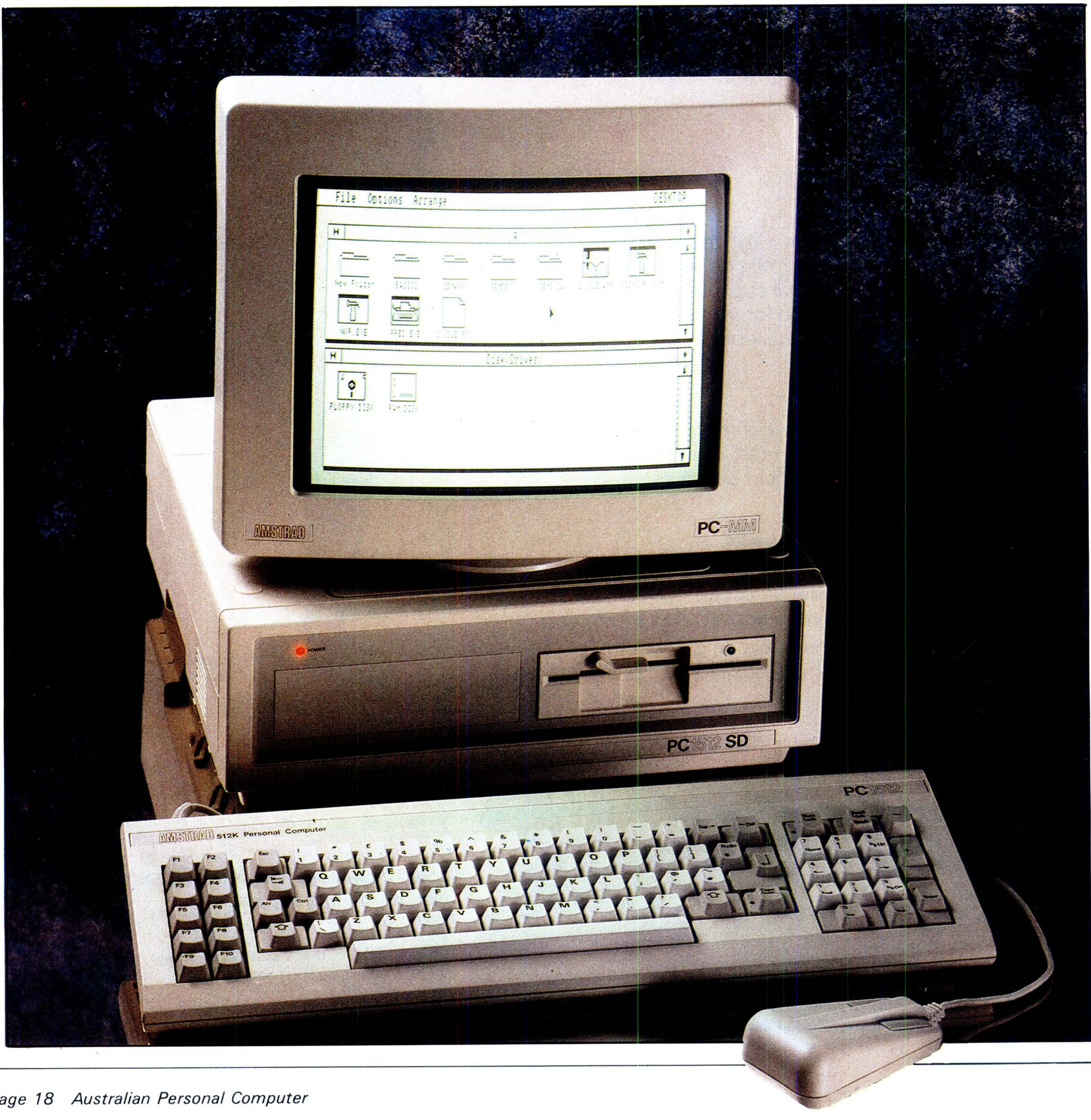
But now that desktop publishing software is becoming available for IBM's Personal Computer, the former Apple chairman is seeing things differently. "The perception is that desktop publishing is a multibillion market," Jobs told the Seybold Desktop Publishing Conference last month. "The reality is that (it) will not be a specific market." Jobs, now president of startup Next Inc, argues that desktop publishing will be so popular that it will become a standard feature on all personal computers within five years. Apple does not disagree. "Desktop publishing is becoming very mainstream," says John M. Scull, Apple's marketing manager for desktop publishing. "But that's not everything the Mac can do. We'll continue to push forward with innovation." END



'Bernard became supreme ruler of the Andromeda galaxy this afternoon.'

Amstrad PC 1512

It seems it's not only the Taiwanese who can produce cheap PC clones. Fast, inexpensive and from a company with apparent 'staying power', the Amstrad PC could be just what you're looking for. Guy Kewney loves it.



There's only one clear reason why someone who wants a micro to run IBM software might not want to buy an Amstrad PC1512. It's the same reason why they might not buy an Olivetti M24: the thing will not work with an enhanced graphics adaptor, an EGA. If you don't know what an EGA is, it probably isn't going to bother you, and all you need to know is the price.

For the rest, the PC1512 is one of the most important micros to appear this year.

It's a calculated gamble from Amstrad, designed to go for a new market — the big-business buyers of PCs — with a machine that appeals to their cost-consciousness. It's also designed to steal as few sales as possible from Amstrad's very successful bread-and-butter machine, the PCW8256.

The PC1512 was code-named AIRO. It stands for Amstrad IBM Rip-Off, and that fits, because it's a neat catalogue of what everybody always wanted in an IBM standard box.

It goes faster than the IBM, it's smaller, has better onscreen colours, and includes, as standard, functions which have to be added (and paid for) separately on normal IBM-style machines.

And as you'll be able to pick one up from around $1450, many people who always wanted a PC can now afford a very nice one.

However, before you skip to the 'Conclusion' section at the end of this Benchtest, it would be as well to pay some attention to the details. This machine is not a conventional PC clone. And perhaps more to the point, so much idle speculation has been wasted on it by people who knew nothing about it, that the chances are very strong that you have some pre-conceived notions about what it is, and what is in it.

Here, for the first time, are the full facts.

In outline, the Amstrad PC is a very fast machine with most IBM PC functions built-in. Its minimal configuration is an Intel 8086 chip, a single 360k disk, 512k of memory, and serial and parallel ports built-in.

The price also includes a paper-white monochrome screen with colour and grey-scale graphics circuitry built into the main board, three expansion slots, a mouse and a keyboard.

Software supplied includes two operating systems: MS-DOS 3.2 and Digital Research's DOS Plus, with the graphics environment driven by GEM, the Digital Research product (graphics environment manager). Also supplied is a new, and very fast and powerful, version of Basic from Locomotive Software, Basic-2. The only applications program supplied is GEM Paint.

Whatever you may have read, however, there is *no* word processing program. There is *no* built-in printer. Sidekick is *not* included. And it does *not* use the V20 processor which runs Intel 8080 code as well as 8088 code.

A colour version of the machine is available, a twin-disk version is available, and a hard disk version is nearly ready, too.

Hardware

There's nothing astonishing about the appearance of the machine, except the mouse attached. At the front, there's space for two floppy disks, or one floppy and one hard disk, side by side. That makes the box a bit narrower than most PCs.

There's a choice of colour, or paper-white monochrome monitor. The mono monitor is very much nicer than a green screen and is a graphics display. Anyone who wants a green, text-only screen will have to buy a standard video card and a standard green monitor, and plug them in separately.

The monitor is purpose-built, with a steep slope down the back to prevent people putting bits of paper up there. Just as well, because the monitor also encloses the main heat generator — the system power supply, exactly as in the first Amstrad home computers. The on/off push-button is on the monitor, at the right back, next to the intensity controls. The advantage of this remote power supply becomes obvious when you come to upgrade.

As there's no mains power in the system box, the EEC laws governing safety don't apply as they do on standard PCs. You can open the box and plug cards in with one hand. EEC rules dictate that you must use two hands if mains power is present.

As a result, Amstrad has been able to put the expansion bus inside at the back, but with a little snap-off lid, so that the normal chore of opening the system to plug in cards is a cinch. On standard PCs, it involves screwdrivers, fingernail chippings, pinched flesh and blasphemy. On the Amstrad, you might have more trouble than you get putting batteries into a Walkman, but that's only because add-in cards are a blessed nuisance to get right. However, there's no obvious reason to plug cards in, because most of the things which people plug into PCs are already there, built into the

This is not a standard, cheap Amstrad bubble keyboard; the keys are mounted in solid plastic with springs

(amazingly small) main circuit board.

At the back are the two sockets which connect to cables from the monitor. One brings power, the other takes the video signal. Next to those are the serial and parallel ports for the modem and the printer (usually).

On the left-hand side of the main box is the socket for the keyboard, half-way back. Next to that is the mouse plug. I would have preferred it to be on the other side — but what the heck. And on the back of the keyboard is a joystick socket.

This joystick, by the way, is not the joystick required by many American games for the PC, but one for future authors to use. Unlike analogue joysticks, this one imitates the computer keyboard.

Next to the joystick is a little volume control. This PC is (astonishly!) the only one which has the ability to make a really audible BEEP! as well as the feebler 'meep!' of the standard machine — and can even be turned down to inaudibility. Don't turn it all the way up, or you'll have a heart attack.

The keyboard opens up by snap fittings, which means that with little effort you can swap keys around. The mechanism of the keyboard is painfully, elegantly simple: two layers of plastic have white circles painted between them. The keys push conductive foil on the top down the fraction of a millimetre needed to connect the top and bottom sheets.

This is not the standard cheap Amstrad bubble keyboard, although it feels very similar. The keys are mounted in solid plastic, with springs. You can type fast and accurately on it. There are a couple of extra keys, which WordStar and Lotus users will like, and other people will probably ignore — a Delete Forward key (generating control-G) and a second Enter key on the numeric keypad.

The keyboard plug is not standard IBM format, and only accepts Amstrad keyboards. Should you require a special-purpose keyboard, one that normally replaces the standard IBM unit, you'll be stuck until when and if someone recognises your need and produces an Amstrad version.

The mouse is fine. It has two buttons, and once Amstrad's version of MS-DOS is loaded, it works like a Microsoft mouse. It worked under PC-DOS with Microsoft's standard IBM mouse drivers, too.

Underneath the monitor, recessed into the main system area, is a socket for ordinary pen-cell batteries to drive a real-time clock. This machine always knows the date and time, and when you last used it. Together with this is a battery-powered memory chip which remembers several important facts about how you like the system to be.

I have to report that, at the time of testing, the colour display was not good, I'm going to assume that, because the engineers at Amstrad noticed the problem, they have been working on it since, and that yellow will show as yellow, not bleached-out white. But don't buy a colour system without having a look at something that shows up these colours. Without the yellow, there isn't much difference between green and blue.

'The PC1512 includes very few chips, most of them logic arrays doing the job of 20 IBM board chips. That's why the machine is cheap. The effect of these chips is to imitate all the tricks of the original IBM . . .'

The machine is driven, exactly as in the standard Olivetti M24, by an Intel 8086 running at 8MHz. The difference between the 8088 (in the IBM and exact clones) and the 8086 is the data bus. All programs run identically, but the 8086 is substantially faster. It does require some clever logic to produce a standard IBM expansion bus, but Amstrad has managed this.

The PC1512 includes very few chips, most of them logic arrays doing the job of 20 IBM board chips. That's why the machine is cheap.

The effect of these special chips is to imitate all the tricks of the original IBM. It's an absolute, cast-iron certainty that there are some tricks the designers didn't know about, and which will make the machine behave differently, in strange circumstances, from the standard IBM.

The trouble with building an expandable system is that you have to decide whether the circuitry on the main board is doing the work, or whether there is something plugged into the bus trying to do the same thing.

Generally, the trick is done electronically by having a switch which can point in one of two directions, and is simple. However, Amstrad has saved some space on its chips by not tristating every circuit on the main board. This does cause one serious problem — it cannot accommodate an enhanced graphics adaptor.

The motherboard of the Amstrad PC produces a 16-colour, grey-scale graphics output. Bright colours are shown correctly on the colour monitor, and as bright grey on the paper-white monitor.

This circuitry is rather nicer than standard IBM colour graphics cards. For most users today, it will exceed their expectations. It isn't as nice as the Olivetti screen, using the standard IBM pixel count, but otherwise, it's pretty good.

There are two reasons why. Firstly, as on the Olivetti, it isn't possible to disable the standard colour graphics output. The system produces the signal and won't stop. And secondly, the 8086, running at 8MHz clock speed, doesn't produce the scan-line timings that the EGA card is looking for on a 4.77MHz 8088 system. Even if you produced a board that didn't have the colour graphics output (only possible on a totally new design) the EGA graphics card still wouldn't work.

When Amstrad designed the machine, there wasn't any good reason to worry about this. The EGA card is slow —

Technical specifications

CPU:	8086 running at 8MHz, switchable to 4.77MHz
ROM:	32k
RAM:	512k expandable to 640k on-board
Keyboard:	Detachable 83-key, full-stroke keyboard
Mass storage:	One 360k, 5¼in disk drive. Additional hard and floppy disk model available
Size:	System unit: 38.4cms x 37.2cms x 13.5cms; mono monitor 35cms x 30cms x 31.5cms; colour monitor 37.2cms x 36.5cms x 33cms; keyboard 46.5cms x 16cms x 5.8cms
Weight:	6.05kg (single disk)
I/O:	Three PC expansion slots: mouse port; 25-way RS232 comms port; Centronics printer port
DOS:	DOS Plus; MS-DOS 3.2; GEM windowing environment
Bundled software:	GEM Paint, Basic-2
Power:	240V A/C

pitifully so. Even when working properly, as one disgruntled user recently complained, 'it works as though it's broken.' As little as a year ago, no-one used it, no software addressed it, and it cost a fortune — well over $3000 if you include the special high-speed scan monitor needed.

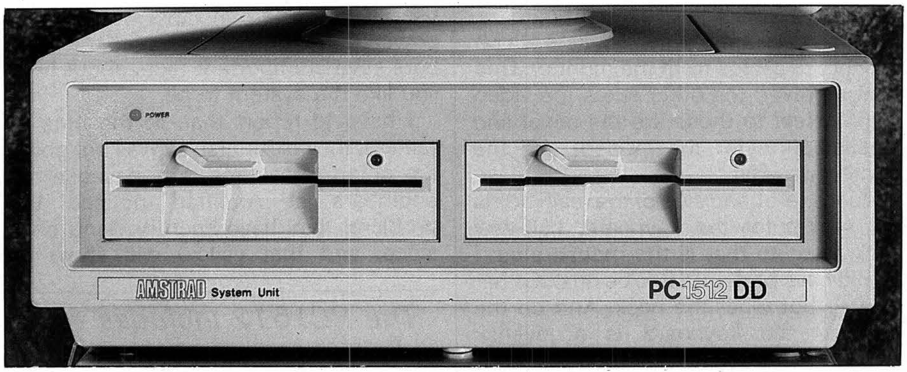
These days it suddenly looks different, with the EGA system being the most-installed add-on in the US and booming over here. It's too late for Amstrad to produce a new design, and the current design can't be upgraded. At the price, I suspect that many people who thought they needed EGA suddenly realise that it isn't essential. But if you *must* have an EGA display, you don't buy an Amstrad. It's that simple.

The comms ports are also built-in, but no-one ever gets worked up about replacing these. Add-on cards provide extra comms ports and don't replace the existing circuitry, so the fact that they can't is irrelevant.

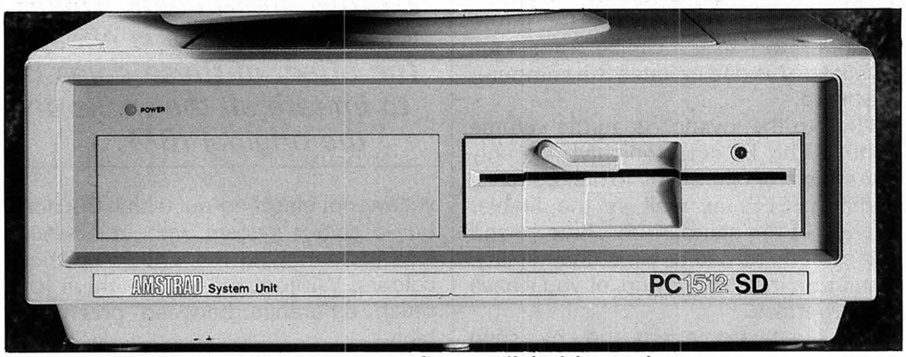
The system has 512k on the motherboard, but the standard Lotus/Intel Extended Memory System has been tested on it, and takes it up to whatever limits the various expansion boards allow. I didn't test it with the AST RAMpage system, however.

Amstrad says that extra chips can be plugged into the motherboard to bring it up to 640k, but this should be done only by Amstrad or one of its dealers. Apparently, it's easy to blow up your new RAM unless you get the motherboard adjustments just right.

A Mountain 20Mbyte drivecard was plugged into the standard bus and worked. So did a Tandon plug-in card, though this had to be installed in the central bus slot. Amstrad assures me that generally, these useful add-ons only fail to work when they rely on a crude software system that does its timing



A 5¼ twin floppy unit is available for an upgrade fee of less than $585



The standard unit contains a single floppy disk drive unit

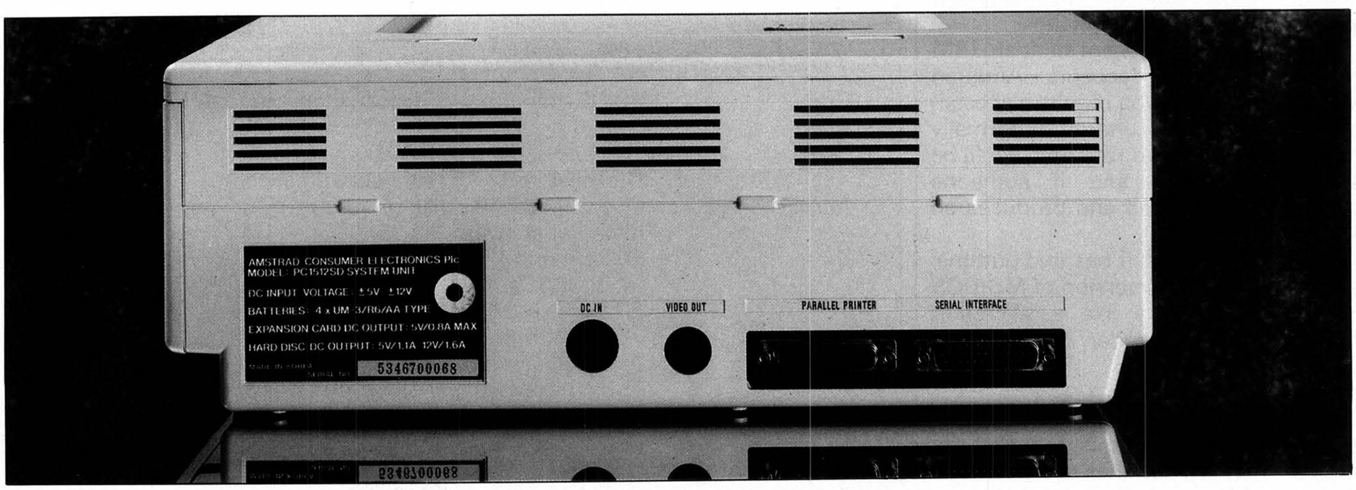
based on a 4.77MHz clock. There are very few such add-ons, since many manufacturers these days go faster than the IBM clock.

A single floppy system can be upgraded to a twin floppy for a standard $585 fee either on-site through a deal between AWA (Amstrad's Australian distributor) and Hills, or by returning the unit to AWA. At press time, upgrade to hard disk was still being priced.

Testing a machine like this on a network is not within the scope of these single-user Benchtests. However, Amstrad assures me that plug-in network cards do work correctly, and since the company hopes for large sales to corporate customers, I believe that it is taking this requirement seriously.

As indicated above, the keyboard has a non-standard connector and doesn't behave, electrically, as if it were a simple IBM keyboard replacement. I don't know why, but if you need to take a special keyboard used in your company and plug it into your clones, you can't use this one. But then, the same applies to most clones.

As the system comes with GEM, it made sense to supply a mouse. Sensibly, this appears to work in all respects as if it were a normal, bus-mounted Microsoft



From left to right: two sockets for the monitor cables, and the parallel and serial ports respectively

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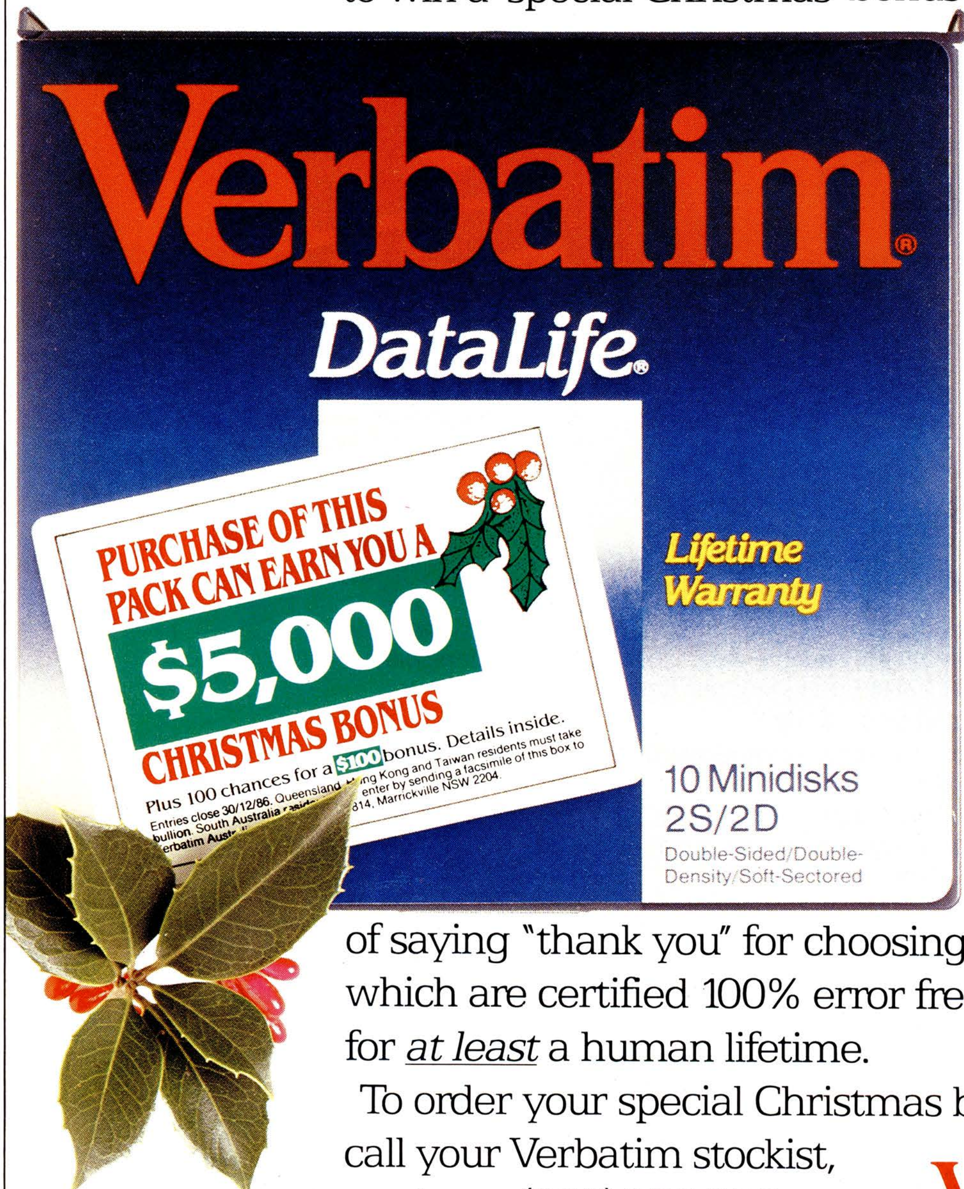

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mouse. Inevitably, there's the risk that someone has written a program which requires a genuine Microsoft bus mouse with the interrupts changed, but I don't know of one.

System software

The machine works perfectly well under MS-DOS and PC-DOS. You can use GEM under MS-DOS. As Amstrad has included DOS Plus, a rival system from Digital Research which is mainly designed to imitate MS-DOS, I can only assume that it got it free when it bought GEM from Digital Research. I'm afraid I'm not going to stand up and say how wonderful GEM is. For someone who has never seen a mouse and graphics, it's probably OK, but for someone used to the far more sophisticated and friendly Macintosh WIMP interface, it's a bit of a giggle. However, you do need GEM to run Basic-2.

There are some advantages to running GEM. The 'desktop' on which programs appear as pieces of code and files appear as pieces of paper, means that you can arrange for files marked .TXT to look for WordStar (say) if someone points at them. But by far the most obvious effect of running GEM is that you suddenly have no memory.

On a 512k machine with Basic-2, plus the GEM fonts plus the operating system plus the clock, calculator and notepad that can pop up from the desktop, with memory for four windows, a request for 64k of data will be met with the discovery that there is only 40k available. On a 640k machine, the printer fonts can be added — and that's your entire memory full. Don't try loading Sidekick.

I feel that GEM will be great for making dumb shop assistants look like skilled salesmen, and I suggest that you quietly put your GEM disks in a safe place until you want to use Basic-2.

Loading GEM for the first time is a long drawn-out nightmare, automated in such a way that I guarantee you get it wrong.

The latest version of Microsoft's operating system has been enhanced on the Amstrad to include the mouse drivers, and the ability to read the real-time clock and system specifications.

With the normal DOS programs, such as FORMAT and CHKDSK, and so on, there's one called NVR.EXE — Non-Volatile RAM executive. This allows you to change: the size of the RAM-disk; the keyboard codes for several keys; the colour and size of the start-up screen; the set-up for the serial port; the joystick buttons; the number of disks; and the way the mouse moves.

The most important is the RAM-disk. With a single-floppy system, this becomes drive c: (the third drive!) because the first drive is both a: and b: under MS-DOS.

The first thing that the Amstrad PC is set up to do, under both operating systems, when it starts up, is to load a program called COMMAND.COM into RAM-disk.

This is necessary due to the real risk of using a DOS Plus diskette when the system is running MS-DOS, or vice versa. As both versions of COMMAND.COM have the same name, and because

> *'. . . It's an absolute cast-iron certainty that there are some tricks the designers didn't know about, and which will make the machine behave differently, in strange circumstances, from the standard IBM.'*

many programs overwrite it during execution and reload it afterwards, an incorrect version of COMMAND.COM 'would tend to be a disappointment to you,' as one systems designer laconically put it.

The RAM-disk is set at 34k at the factory.

All that is by way of saying that the only unusual things about MS-DOS on this machine are the things designed to cope with co-existence with DOS Plus, or the mouse.

There's a neat improvement, too. On this version, if you forget to format a disk with /S (putting system tracks on, so that it can be used to boot up the system) you can add them afterwards. Quite often, surprisingly, you can't on normal MS-DOS systems.

The specially-commissioned version of Basic supplied to Amstrad by Locomotive Software is incredibly fast, and a great deal more powerful than the standard GW-Basic supplied by Microsoft. Amstrad doesn't provide GW-Basic, but it works OK if you buy it from Microsoft. Just about any version seems to be fine. Unfortunately, the version of Basic-2 provided free with the Amstrad isn't quite as good as the version which Locomotive is selling separately for PC users.

There are two main differences between Microsoft Basic and Locomotive Basic-2 (apart from the fact that Locomotive's version goes at least twice as fast). Firstly, Basic-2 uses GEM (enhanced and improved) to do complex window management, graphics, turtle graphics and mouse controls. And secondly, it's very much more sensible and straightforward in the way it handles disk files and database work.

The full list of Basic keywords is included in the program. The interesting thing to look for is the list of MS-DOS commands — DIR, MKDIR, RMDIR, RD, DELETE, DEL, and so on.

The points of most interest to Basic experts are the file and flow-control commands. Compare them with a list of standard ones, and buy the extra manual available from Amstrad, and you'll be amazed.

I'm not an expert Basic programmer, so I took one along to help analyse its capabilities. She had just written a complex database application in Locomotive's Mallard Basic, as supplied with the PCW8256, which is much more powerful than Microsoft's version, but Basic-2 made her very excited indeed.

Applications software

Supplied free with the system is GEM Paint. Included in the utilities is a nice little screen-based text editor called RPED, Roland Perry's Editor. It's great for making new batch files, config.sys files, and so on. Frankly. I'd rather have that than Paint, but some people love it (Paint, that is).

Benchmarks: The standard GW-Basic Benchmarks ran nearly three times

In perspective

Unlike many other clone builders, Amstrad is a substantial company and unlikely to disappear overnight. Add the software companies' enthusiasm for low prices and you have a formula for a successful product.

If you are planning to buy an Amstrad PC for business purposes, you must be aware that buying the machine is only part of the story. You may have, quite rightly, saved a few dollars on the purchase price of your hardware and software, but you must remember that staff training (or your own learning), data loading and good old-fashioned mistakes can be time-consuming and costly.

With its range of options spanning paper-white to colour screens, single-floppy to 20Mbyte hard disk systems, you will be hard pushed to find better value for money.

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faster on the Amstrad PC than on the IBM PC. This doesn't test disk speed, mouse handling or graphics.

Running the tests on the Amstrad, using Locomotive's new Basic-2, the timings shown in the Benchmarks box made the PC1512 look (on paper) faster than a fast PC/AT compatible. It only goes to show how hard it is to prove anything using the traditional Benchmarks. (A new set of Benchmarks has been prepared to test new machines — see the article elsewhere in this issue).

Don't expect the Amstrad PC1512 to run Lotus sorts at five times the speed of a standard PC. To quote a Locomotive spokesman:

'Running the standard Benchmarks on the Amstrad, using standard Basic, gives much the expected results for an 8MHz 8086 machine.

'But it's usual to Benchmark machines using the Basic shipped with the machine. Looking down the list of machines so far tested, the only personal computer which comes close to the Amstrad is the Apricot XENi (reviewed last month).

'There should be no confusion about what these results really mean. The *APC* Basic Benchmarks test a hardware and software combination. The Amstrad PC1512 is a fast machine, and Basic-2 is a fast Basic.'

Benchmarks

	Amstrad PC1512	IBM PC
BM1	0.22	1.5
BM2	0.82	5.2
BM3	2.03	12.1
BM4	2.03	12.6
BM5	2.25	13.6
BM6	4.23	23.5
BM7	7.63	37.4
BM8	6.28	35.0
Average	3.18	17.61

Compare Benchmarks 7 & 8!
All timings in seconds. For a full listing of the Benchmark programs, see Endzone.

Documentation

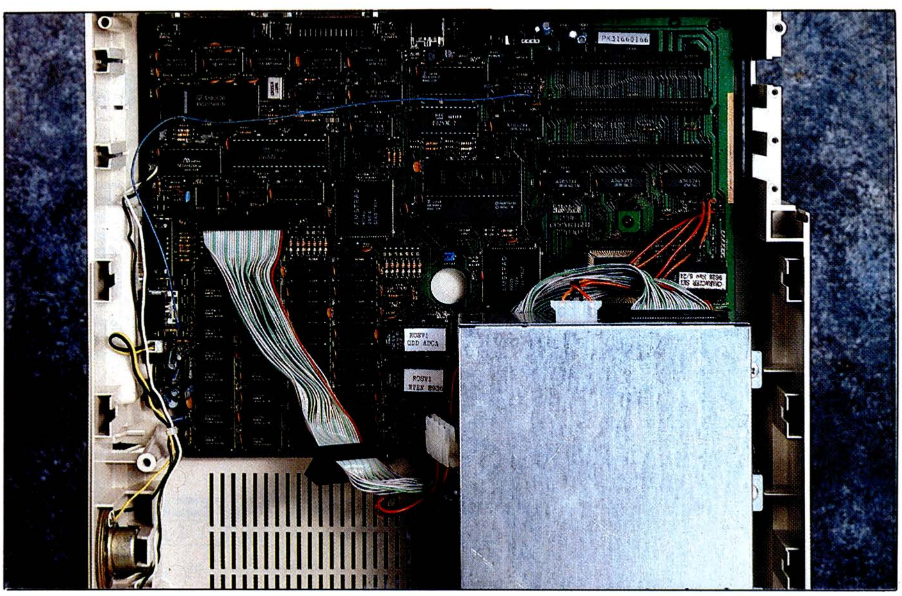
My pre-production version of the manual wasn't much of a guide to the real thing. Amstrad staff are proud of it, and pointed out various nice features. On the other hand, outside experts tell me that they see the thing as a splendid publishing opportunity, and propose to launch their own, superior products forthwith.

I found it confusing, never really knowing whether a command was for MS-DOS or DOS Plus. There are differences. And I think there ought to be more information on Basic-2.

I'd say that the standard of MS-DOS manual-writing is pretty low, and that this is an unusually good example of the art. That doesn't contradict either point of view.

Prices

It's impossible to give definite prices for this machine as, even by AWA's admission, there's going to be substantial discounts offered by dealers. While the basic machine with single diskette, paper-white monitor, 512k, two operating systems, GEM, a mouse, a keyboard and manuals has a recommended retail price of $1789, it will certainly



The PC1512 contains very few chips; these imitate the 'tricks' of the IBM

be available for less than $1500 and possibly less than $1400. Other recommended retail prices quoted below are likely to be similarly discounted.

A 'standard' PC configuration should be defined as an expandable two-floppy system with serial and parallel cards, a colour graphics card, 512k, a keyboard, a mono display and DOS. Amstrad's rrp is $2299 and provides as extra: DOS Plus, GEM, GEM Paint, a mouse, a real-time clock, desktop GEM programs, and a central processor running roughly twice as fast as the standard model.

A colour system with one diskette costs $2255. Both 10 and 20Mb hard disks will be available and will be fitted in Australia. No pricing is available for these yet.

A version of WordStar will be sold with the system for $199, and a version of the SuperCalc 3 spreadsheet at the same price. The Amstrad PC is scheduled to be released in early December.

Conclusion

For the life of me, I can't suggest why you'd want any other version of the standard PC, now that this machine is available. The Amstrad PC's only serious defect is its inability to accept EGA high-resolution graphics cards. And it would be nice to clarify, for potential buyers, the importance of this fact. Unfortunately, there's no way to be sure what the future will bring.

For people who want this, today, the choice is easy — don't buy the Amstrad.

'The Amstrad PC's only serious defect is its inability to accept EGA high-resolution graphics cards. Most of us simply don't need EGA cards — or at least, not yet . . .'

There are now cheap AT lookalikes on the market at $3500, including EGA card, screen and 640k. Those machines, with the 80286 chip, clearly will run faster than the Amstrad — and frankly, to run EGA graphics, you really do need a very fast machine.

Most of us simply don't need EGA cards — or at least, not yet, and not for another year or so. There simply isn't any program which is a big selling essential which *must* have EGA to run, so Amstrad probably won't lose sales.

Do remember that Amstrad is not a charity, however. The company is now convinced that the EGA capability is something it will need one day, and its record on such matters was clearly shown when it launched the CPC6128 and dumped the older CPC664 straight out the window, to cries of rage from users who wouldn't have bought a 664 if they'd realised the 128 was coming, hot on its heels.

That's the only doubt in my mind. The machine is fast, easier to use than any other PC, as cheap as anything with the same specification, and comes from a company now regarded as a good survival bet.

Because the Amstrad PC has a mouse built-in, software will be written for it that uses the mouse. Because it's cheap, cheap software will be sold for it. Because it's expandable, it will sell into areas where Amstrad 8-bit machines won't go. What more could you want?

END

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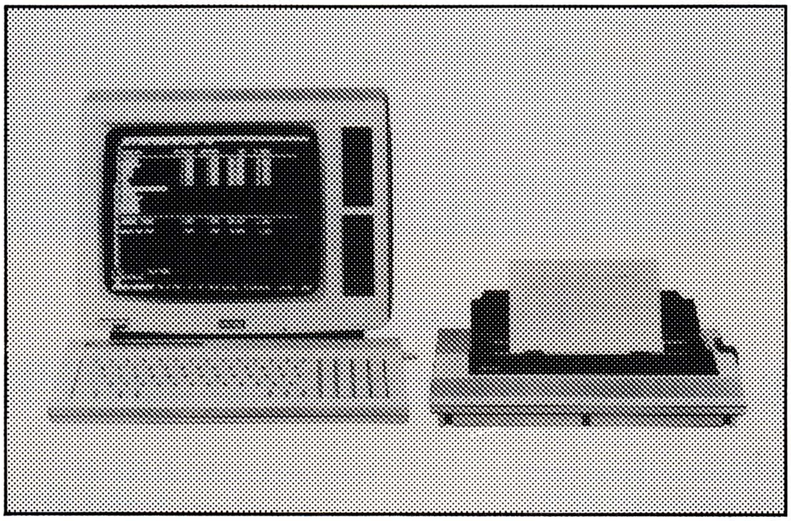

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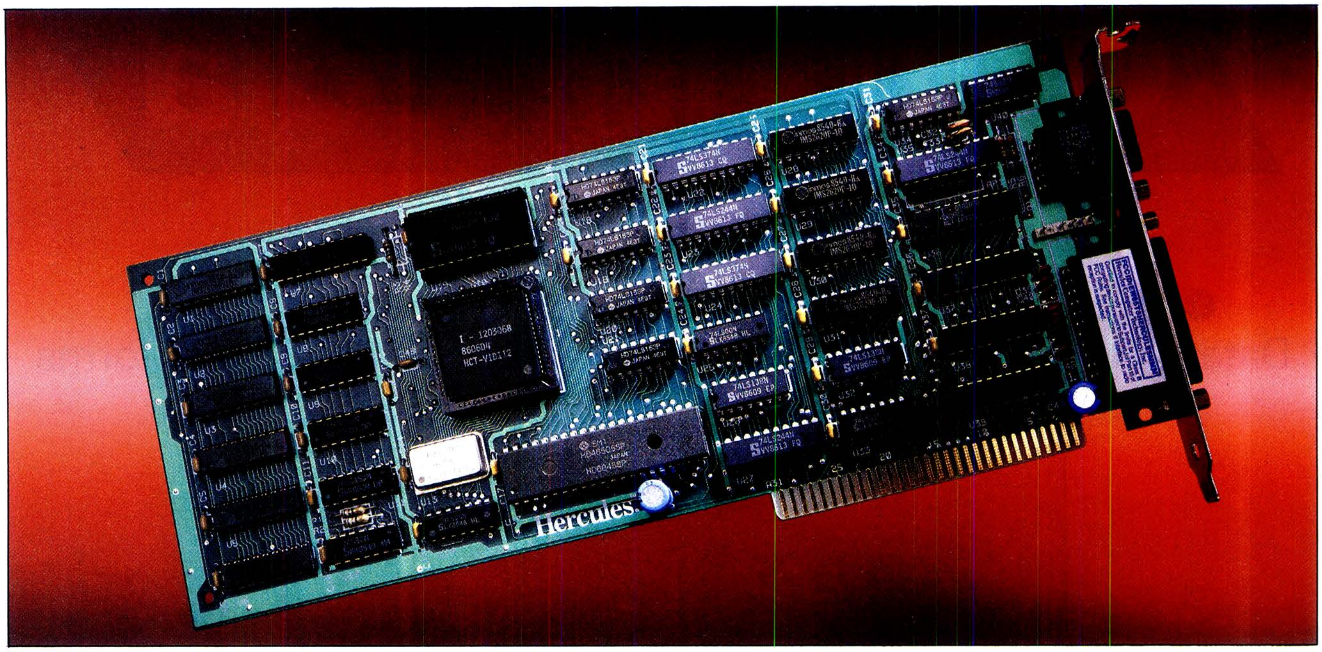


Introducing
The Hercules Graphics Card Plus

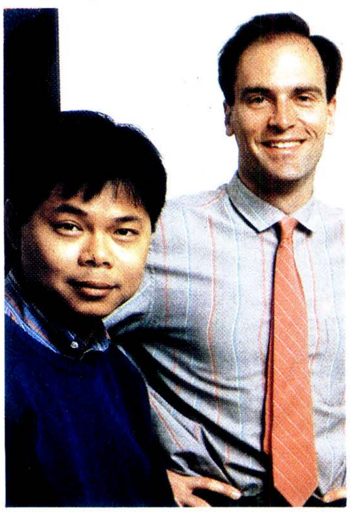
It's 100% compatible with our original card and costs 40% less. And that's not even the reason to buy one.

The reason is RamFont, an entirely new mode of operation that is unique to the Graphics Card Plus.

The idea for RamFont first occurred to Hercules co-founder and chief engineer Van Suwannukul, two years ago.

At the time he was working with Microsoft engineers on their new word processor, later known as Microsoft Word.

Microsoft's engineers knew that soon there would be very high resolution laser printers offering multiple typefaces.



VAN SUWANUKUL AND KEVIN JENKINS, CO-FOUNDERS HERCULES

They reasoned that if you could print italics and boldface, you should be able to see italics and boldface on the display.

Unfortunately, the Microsoft engineers were ahead of their time.

It was not possible, with the graphics cards that existed at the time, to get both the flexibility to display multiple typefaces, and the speed that is essential to a word processor.

Van knew that to solve Microsoft's problem, new hardware would be needed.

So he invented RamFont.

Word 3 – Three times faster.

Two years later, the Hercules Graphics Card Plus was ready.

What Van had developed was RamFont, an new mode that could store, and then display at lightning speed, 3072 programmable characters.

By this time, Microsoft's engineers had used every trick in the book to speed up Word, and succeeded in making Word 3 considerably faster than earlier versions.

However, for many users it still wasn't fast enough.

So you can imagine how delighted Microsoft's engineers were when they saw Word 3 running over three times faster on the Hercules Graphics Card Plus.

At last their word processor could really process.

1-2-3 Release 2 fulfills its promise

At Hercules, we knew that this was just the tip of the iceberg. RamFont was a revolution waiting to happen.

The more we used it, the more possibilities opened up.

Take 1-2-3 Release 2 for example.

Release 2 has an optional character set that nearly doubles the size of the viewable spreadsheet.

It's a great idea . . . until you try scrolling up and down or right and left. It takes forever.

As RamFont has the ability to display characters ranging in size from 8 by 4 to 9 by 16, it was easy to adapt Release 2's smaller characters.

The result is that now you can scroll a far larger spreadsheet as fast as version 1A could scroll a smaller one.

Then another idea occurred to us.

If RamFont could be programmed to display characters, why couldn't it be programmed to display graphics?

Well, it turned out it could.

So we did a bit more work and now you can draw 1-2-3 graphs in a window on top of your spreadsheet, and view your data in the background.

(Or, you can still view a graph on a full screen if you prefer.)

LOTUS 1-2-3 RELEASE 2

We liked what RamFont did for Word and 1-2-3 so much we did the same thing for Symphony and Framework.

Can a graphics card be a work of art?

Van will tell you that the Hercules Graphics Card Plus is the best monochrome graphics card he's ever designed.

Which is significant because 1) Van is not given to exaggeration, and 2) his three previous designs have met with a certain degree of success.

What makes the Graphics Card Plus so good is a chip Van designed called the V112.

The V112 does three things.

First, it runs every single one of the thousands of programs written for the IBM Monochrome Display/Printer Adapter.

Second, it runs every single program written for the famous Hercules 720 × 348 graphics standard.

And third, it makes RamFont possible.

Survival of the fittest

Actually, chips like the V112 do something else.

They make our products even more reliable.

One chip manufacturer was astonished when we told him that we test 100% of the nodes on a chip. He said 93% was common.

By testing each chip individually to such high specifications, we are able to weed out weak V112s before they go to assembly.

V112

Then we subject the survivors to more testing at temperatures above 70°C, weeding out whatever weaklings are left.

After the V112 has been thoroughly tested, we insert it into a fully assembled Graphics Card Plus. (Incidentally, all our PC boards are 100% tested, which is another rarity.)

Then batches of the finished product are heated in ovens to greater temperatures than you are ever likely to encounter.

While still hot, the Graphics Card Plus is placed in a PC just like the one you use, and we run special software that exhaustively tests all functions.

Then, as a final precaution, each tested unit is carefully placed in an anti-static bag to protect it during shipment.

Free software, and parallel ports.

Hercules has become famous for the software we include with each monochrome graphics card.

And the Graphics Card Plus has the best software yet.

You get a program to extend the life of your monitor.

And to print graphics.

Then Fontman, a program that makes it easy to create your own RamFont characters.

Plus 25 fonts to get you started.

Plus everything you need to run 1-2-3 Release 2, Microsoft Word 3, Symphony 1.1, and Framework II.

And the Graphics Card Plus comes with a parallel printer port that you can disable. (Some PC compatibles require this.)

What price perfection?

With the RamFont breakthrough, 100% compatibility with our original card, free software, a parallel printer port, and the Hercules Graphics Card Plus should cost at least $1200.

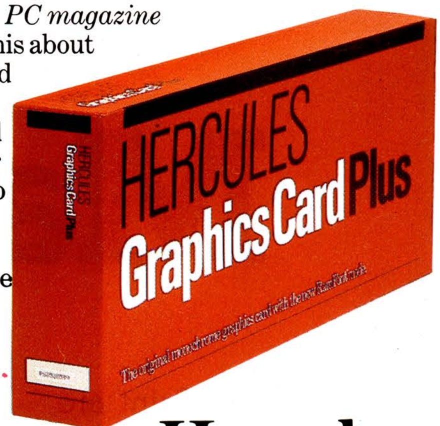
Surprise. Its suggested list price is only $595 ex. tax.

If you think that the Graphics Card Plus must be the ultimate monochrome card, you're not alone.

John Dvorak, *PC magazine* columnist, said this about the Graphics Card Plus:

"If you intend to buy an IBM or clone and want to run a monochrome system, this is the card to get. I wouldn't even think about anything else."

Neither would we.



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Business graphics

Presenting your business information in graphic form may be just the boost your company needs, and you don't have to be a great artist to do so either. Nick Walker takes a look at what's available and puts you in the picture.

To the uninitiated, the screen of a micro running a spreadsheet is a perfect example of everything that's wrong with computers — rows and rows of seemingly meaningless figures. To you those figures may indicate the most significant discovery in your company's history, but, unless presented in a meaningful form, they may as well be a hex dump of RAM.

Many modern spreadsheets, such as Lotus 1-2-3, contain a facility for showing a set of figures as a graph. Graphs are fine for showing a colleague your discoveries, but are not generally of presentation quality. For some time now there have been packages available that take the data from the likes of 1-2-3 and turn it into much higher quality graphs. The quality of these products has steadily improved over the last two years, so much so that I decided that the time was right to examine the most promising of the current crop.

To assist me in my choice I set some criteria to which all the packages had to conform. Firstly, they had to run on an IBM PC or compatible. (I didn't really want to stipulate this, but it *is* the machine that both small and large businesses most commonly use when running spreadsheets). Secondly, they had to be able to display graphs in both CGA mode (colour graphic adaptor) and one of the higher graphics modes such as EGA (enhanced graphics adaptor) or Hercules.

CGA is by far the most common colour graphics standard used with the IBM PC, but its low resolution and lack of colours pose problems to anyone trying to produce decent graphics. EGA is IBM's attempt to produce a higher quality colour graphics standard, which despite its high price (if bought from IBM) seems well on the way to becoming the second IBM colour standard. Hercules is by far the most successful third party, high-resolution monochrome for the PC.

Two final criteria I expect from a decent IBM graphics package are that it must be able to take data from a Lotus 1-2-3 spreadsheet and be capable of producing a good quality hard copy of what's shown on the screen. A surprising number of the older packages don't support peripherals capable of high quality graphical output.

You may think that there would be few packages that satisfied such a specification, but I discovered well over 20. I picked two, both relatively new packages to the market and each with a very different approach to the creation of graphics. Those selected for review were 'Harvard', a full-blown presentation graphics system from Software Publishing Corporation and Perspective from Three D Graphics, a package whose *forte* is three-dimensional graphics.

Obtaining the necessary hardware for this review was no great problem, except for one thing — an EGA colour display. No end of manufacturers and distributors offered me plug-in expansion cards which provide EGA output, but no-one seemed to have a suitable colour display. Finally, after much searching, I was able to obtain a genuine IBM one.

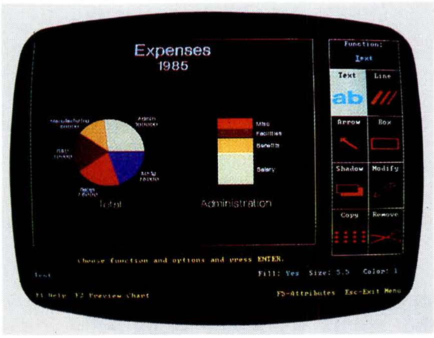
Harvard Presentation Graphics

To install Harvard you need a 256k RAM system with two floppies or one hard disk, version 2.0 (or greater) of the MS-DOS operating system, an 80-column monitor and either a CGA, EGA, Hercules or IBM monochrome display card (although you can't see the graphs on the screen with the IBM mono set-up). The installation process is executed via a batch program called 'INSTALL'. Once installed it is impossible to load the program on another system until it is de-installed; a nicer form of copy protection than the key-disk system but still not perfect.

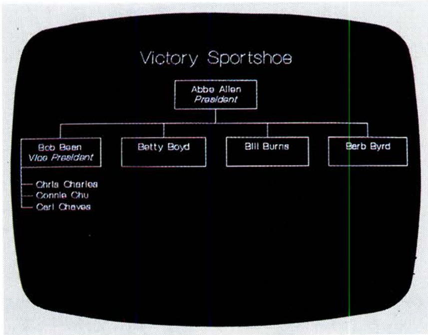
When you first start Harvard, it displays a main menu from which you select each of the program's major functions. Unlike most graphing packages that have a general data entry screen, Harvard has a different data entry screen for each of its graph types.

A pie chart is the easiest graph to create with Harvard, although this has much to do with pie charts being used to graph only one set of variables rather than being an easy-to-use feature of the package. To get to the pie data form, you select 'Create graph' from the main menu and then 'Pie' from a second menu. The menu structure is the same throughout the package, so I won't bore you with the details.

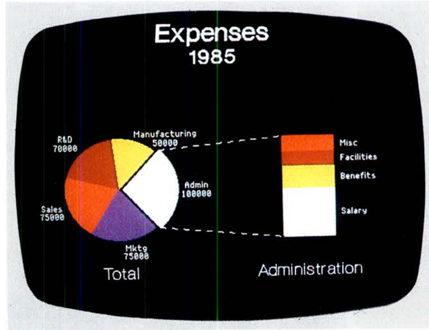
For some reason, with graphing programs, I find a menu system far less irritating than with other programs, even with repetitive use. The data entry form lets you enter the graph title, subtitle, footnote and, for each segment of your graph, a value and label. A number of options can be applied to enhance the pie chart's appearance, including showing a slice as a cut-out for extra emphasis, changing the colour or fill style of each slice, adding percentage or currency signs and creating a three-dimension



Harvard's annotation screen



An organisational chart



A pie and column chart

effect. Two pie charts can be displayed on the screen and one can be linked so as to show a breakdown of a single segment. Finally, if you desire, pie chart-style data can be shown as a single broken-down column. A particularly effective combination image wise is a pie chart together with a column on the same screen.

Line and bar charts add another dimension to the type and amount of data that you can handle. Before entering the data input form, a window will appear requesting information about the x-axis, specifically the units (that is, name, day, week, month, year, time, number and others), the start value, the end value and the increment. The data entry screen will then be suitably customised and ready for the entry of y-axis data. Up to eight series of data can be displayed on a single chart with up to 60 values per series, although it is obviously wise to keep the number low if you want an easily understandable graph.

There are so many customised options available for these types of graph that Harvard has broken them down into three pages of options. These pages of options are filled in just like the data entry forms.

From page one you can change the title, subtitle or footnote. You can also type a title for the X and Y axes. In the table at the bottom of the screen you can change the legends of each series in the graph, select the graph type (bar, line, trend, curve and point) and specify if you want the graph sorted or cumulative.

From page two you choose overlapped bars, stacked or 100 per cent bars or lines. You also select the type of grid lines (if any), a label for the values shown along the Y-axis, the style of the frame and the placement and justification of legends. For bar charts, you can specify that Harvard displays the bars with a three-dimensional appearance or with values above the bars. You can also indicate whether the bars are to run horizontally or vertically.

Finally, on page three, you can choose the colour of the lines or bars, the marker style for line or point chart, the pattern for bar charts, and the line style for any of the variations of line charts.

Two other types of graph are available from the 'Create New chart' sub-menu. These are the area chart — a cross between a line graph and a stacked bar — and the high/low/close graph used almost exclusively to show the high point, low point and closing price of stocks and shares. These graphs are really variations on the bar/line graph theme and use limited forms of the bar/line graph data entry screens.

Harvard Presentation Graphics, however, is more than just a graphing program; it is an attempt to provide everything you need to make a complete presentation. A substantial proportion of the program is concerned with other aspects of creating a presentation. There are facilities for the creation of many types of text chart. Among these are hierarchical charts, which are used to show company structure; and bullet lists, which give visual impact to a list and tabular charts.

One of the most useful features of Harvard is its annotation facility. This takes any chart created with Harvard and loads it into the window of an annotation screen. A graphical menu of the tools available to add the finishing touches to the graph is shown on the right-hand side of the screen. From this menu you can add extra text, draw lines, position arrows, draw boxes, copy any part of the graph and remove any part of the graph. (Users of MacPaint or similar painting packages will feel quickly at ease with the operation of the annotation screen, as Harvard is based on the same principles).

Harvard will import and export to a number of different commercial packages. From Lotus 1-2-3 and Symphony you can import a worksheet directly into a data entry screen and you can import a Lotus 1-2-3 or Symphony graph directly into its much improved Harvard equivalent. For other applications the data has to be in the form of an ASCII file, and the procedure is considerably more complex. A graph generated by Harvard can be exported but only to one particular package, the word processor PFS:WRITE.

The choice of output devices for your finished graph is the most impressive list I've ever seen for a single package, and consists of around 30 printers including a number of laser printers, 12 plotters and four colour slide peripherals. The chances are that even if your printer is not listed it will behave like one of those listed; if not, considerable information is included in the manual for those who feel confident enough to design their own printer driver.

The documentation consists of one excellent 200-page manual which is well written, easy to understand and well illustrated. It is also one of the few manuals which successfully combines tutorial and reference information in one book.

Perspective

It was only half-way through the review of Perspective that I realised that it didn't conform to the criteria I had specified. Perspective will not run on a CGA-driven monitor; the manual fails to mention this, and I foolishly assumed, as I happily worked away on both EGA and Hercules set-ups, that this popular standard was supported.

Also, the existing version does not produce colour graphics. This, along with several other features including greater control over annotations, scaling and maths capability are promised in a future version which is "due shortly" according to Three D Graphics.

By the time I realised that CGA wasn't supported, I was so impressed with what Perspective could do that I felt I had to review it anyway. I suspect that there was no way that Perspective's programmers could get anywhere near the standard of graphics they wanted from CGA — even so it's a serious omission. The other hardware requirements needed to run Perspective are an IBM or compatible with 512k RAM, DOS

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- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19036 **$17.95**

CL7
- 15 pin 'D' plug to 15 pin 'D' plug
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19016 **$24.95**

CL8
- 15 pin 'D' plug to 15 pin 'D' socket
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19017 **$27.95**

CL10
- 25 pin 'D' plug to 25 pin 'D' plug
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 1.5 metres

Cat. P19011 **$26.95**

CL11
- 25 pin 'D' plug to 25 pin 'D' plug
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 3 metres

Cat. P19009 **$23.50**

CL12
- 25 pin 'D' plug to 25 pin 'D' plug
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 7.5 metres

Cat. P19037 **$25.95**

CL13
- 25 pin 'D' plug to 25 pin 'D' socket
- Pins 1 through to 8 and 20 wired straight through (removable terminals)
- Length 3 metres

Cat. P19020 **$29.95**

CL21
- 25 pin 'D' plug to 25 pin 'D' plug
- All pins wired straight through (removable terminals)
- Length 1.5 metres

Cat. P19007 **$33.95**

CL22
- 25 pin 'D' plug to 25 pin 'D' plug
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19008 **$41.95**

CL23
- 25 pin 'D' plug to 25 pin 'D' socket
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19012 **$42.50**

CL25
- 36 pin Centronics plug to 36 pin Centronics plug
- All pins wired straight through
- Length 2.13 metres

Cat. P19014 **$49.95**

CL27
- Apple II, IIe, II+, with parallel interface card
- Dual 10 pin (20 contacts) connector to Centronics 36 pin plug
- Length 2.4 metres

Cat. P19025 **$29.95**

CL28
- Apple III with universal parallel interface card
- Dual 10 pin (20 contacts) on Apple end to Centronics 36 pin plug
- Length 2.4 metres

Cat. P19026 **$29.95**

CL30
- Tandy II/12/16/16B/2000, with dual 17 pin female on computer end to Centronics 36 pin plug. (Equivalent to 26-1323)
- Length 2.4 metres

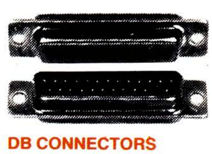
Cat. P19027 **$33.95**

CL31
- Tandy I/III/4/4P, with 34 pin edge connector on computer end to Centronics 36 pin plug. (Equivalent to 26-1401)
- Length 2.4 metres

Cat. P19028 **$37.95**

CL33
- IBM PC, XT and look-a-likes with 25 pin 'D' plug on computer end to Centronics 36 pin plug.
- Length 2.13 metres

Cat. P19029 **$44.95**



DB CONNECTORS

Cat. No.	Description	Price
P10880	DE9P Male	$1.95
P10881	DE9S Female	$2.25
P10882	DE9C Cover	$1.20
P10884	DE9P R.A. Plug	$3.65
P10885	DE9S R.A. Skt	$4.25
P10890	DA15P Male	$2.10
P10891	DA15S Female	$2.25
P10892	DA15C Cover	$1.25
P10894	DA15P R.A. Plug	$4.25
P10895	DA15S R.A. Skt	$5.00
P10900	DB25P Male	$2.75
P10901	DB25S Female	$2.95
P10902	DB25C Cover	$1.25
P10904	DB25P R.A. Plug	$4.50
P10905	DB25S R.A. Skt	$5.95

TELEPHONE EXTENSION CABLE
- U.S. plug to 2 U.S. sockets
- Length 10 metres
- Cream colour cable

Cat. Y16028 **$10.95**

TELECOMMUNICATION EXTENSION LEADS

Cat Y16010	5m	$12.50
Cat Y16012	10m	$14.95

TELECOMMUNICATIONS AUSTRALIAN STYLE ADAPTOR CABLE
- Australian socket to plug/socket
- Length 10 metres

Cat. Y16015 .... **$15.95**

TELEPHONE ADAPTOR
- Australian plug to U.S. socket
- Length 10cm

Cat. Y16026 .... **$6.95**

rie

Rod Irving Electronics
48 A'Beckett St, MELBOURNE
Phone (03) 663 6151
425 High St, NORTHCOTE
Phone (03) 489 8866
Mail Order and Correspondence:
P.O. Box 620, CLAYTON 3168
Telex: AA 151938

MAIL ORDER HOTLINE
(03) 543 7877
(2 lines)

POSTAGE RATES:

$1 – $9.99	$2.00
$10 – $24.99	$3.00
$25 – $49.99	$4.00
$50 – $99.99	$5.00
$100 – $199	$7.50
$200 – $499	$10.00
$500 plus	$12.50

This is for basic postage only. Comet Road Freight, bulky and fragile items will be charged at different rates.

Certified Post for orders over $100 included free!
Registered Post for orders over $200 incuded free!

All sales tax exempt orders and wholesale inquiries to:
RITRONICS WHOLESALE,
56 Renver Rd, Clayton.
Ph. (03) 543 2166 (3 lines)

Errors and omissions excepted

*Apple and IBM are registered trade names

bankcard MasterCard VISA

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

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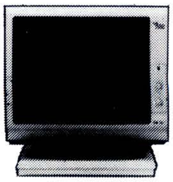
FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!



RITRON 2 MONITORS
Stylish, swivel base monitor, available in amber or green.
Green Cat. X14506 **Normally $235**
Amber Cat. X14508 **Normally $239**
SPECIAL, ONLY $199

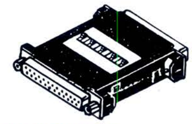
SAVE $9

CENTRONICS GENDER CHANGER
- Female to Female.
- Saves modifying or replacing non-mating Centronics cables.
- All 36 pins wired straight through.

Cat. X15662 ...... **Normally $33.95**
SPECIAL, ONLY $24.95

SAVE $2

RS232 GENDER CHANGERS
Saves modifying or replacing non-mating RS232 cables by changing from male to female to male. All 25 pins wired straight through
Male adaptor to join 2 female ends
Cat. X15650 ...... **Normally $19.95**
Female adaptor to join 2 male ends
Cat. X15652 ...... **Normally $19.95**
SPECIAL, ONLY $17.95ea



RS232 INLINE SWITCHING BOX
- 25 pin "D" plug to 25 pin "D" socket
- DIP switches allow easy switching of internal wiring.

Cat. X15662 .... **$32.95**

SAVE $7

RS232 MINI TESTER
- Male to female connections
- All pin wired straight through
- Dual colour LED indicates activity and direction on 7 lines
- No batteries or power required

T.D. Transmit Data
D.S.R. Data Set Ready
R.D. Receive Data
C.D. Carrier Detect
R.T.S. Request to Send
D.T.R. Data Terminal Ready
C.T.S. Clear to Send
Cat. X15656 ...... **Normally $39.95**
SPECIAL, ONLY $32.95

TRACKBALL
Durable, accurate and reliable, and with dual fire buttons, these new trackballs are suitable for use with the Commodore VIC-20, Atari home video game, Atari 400 and 800 home computer and Sears Arcade Game.
Cat. C14225 .... **$39.95**

TTL MONITORS
Fantastic resolution! Enjoy a crisp, sharp image with the latest Ritron TTL monitor! IBM* compatible, green display, swivel and tilt base.
Green Cat. X14510 **Normally $289**
Amber Cat. X14512 **Normally $289**
SPECIAL, ONLY $269

SAVE $4

RS232 MINI PATCH BOX
- Interface RS232 devices
- With male to female 25 pin inputs
- 25 leads with tinned end supplied
- Complete with instructions

Cat. X15654 ...... **Normally $25.95**
SPECIAL, ONLY $21.95

SAVE $3

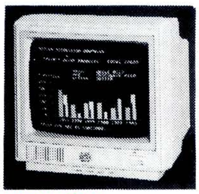
RS232C NULL MODEM ADAPTOR
- Male to female connections
- Pins 2 and 3 reversed
- All 25 pins connected

Cat. X15658 .... **$22.95**
SPECIAL, ONLY $19.95

RS232 SURGE PROTECTOR
- Avoids costly damage from large voltage peaks caused by lightning or other power problems
- Uses metal oxide varistors (M.O.V.) to suppress any voltage above 26V on pins 2,3 and 7.
- Will handle up to 1 Joule and 250A peak current.

Cat. X15660 .... **$34.95**

Rod Irving Electronics No. 1 for peripherals



INTRA RGB COLOUR MONITOR!
Size: 14 inch
Sync. Horiz. Scan Freq: 15.75 KHz
Sync. Vert. Scan Freq: 50 Hz
Band width: 18 MHz
Dot Pitch: .31mm
Resolution: 640 x 200 dots
Display Format: 80 x 25 Characters
Display Colours: 16 colours.
Input Connector: 9 pin D type
Cat. X14520 .... **only $695**

ANTI GLARE SCREEN
Half the price of other brands!!
Relieve eye strain and headaches and increase productivity with these Anti Glare Screens. Suitable for 12" monochrome and colour monitors.
Cat. X99995 .... **$24.95**

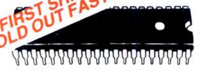
IC SPECIALS!

	1-9	10+	100+
555 8pin	0.50	0.40	0.35
4116	$3.95	$3.75	$3.50
4164	$3.95	$3.75	$3.50
2716	$8.90	$8.50	$8.30
2732	$8.25	$7.95	$7.50
2764	$6.25	$5.95	$5.00
27128	$6.95	$6.50	$6.25
6116	$2.95	$2.75	$2.50
41256	$5.95	$5.50	$4.95
6264	$6.50	$5.50	$5.25
27256	$11.50	$10.50	$10.00

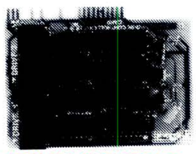
WORLD MODEM CHIP
Cat. U21614 .... Normally $49.50
Save $20, SPECIAL $24.95

MEL9501
Have you blown up your Apple drive by plugging it in backwards or not turning off the power while changing bauds? We have the MEL9501 chip!
SPECIAL, ONLY $29.95

THE FIRST SHIPMENT SOLD OUT FAST!!



SPEECH SYNTHESISER CHIPS!
SPO256A-AL2: Speech synthesiser chip, needs programming to work.
.... **$16.95**
CTS256-AL2: Contains the code recognition circuit to enable the project to plug directly on the printer port, or into an IBM PC.
.... **$29.95**
A SET OF EACH . $44.95



APPLE COMPATIBLE CARDS!

PRINTER CARD
"Grappler" style card allows hi-resolution screen dumps to your Epson compatible printers. Fully functioned for flexible flow of output.
Cat. X17029 **$89**

80 COLUMN CARD
Ideal for use with CP/M. Your computer becomes capable of upper and lower case, with a full width screen of 80 characters. If you want to run Wordstar, or any good wordprocessing software, get this card.
Cat. X17019 **$85**

SPEECH CARD
Simple to use, software controlled speech synthesiser kit. Complete with demonstration programs and text to speech software. Impress your friends with your talking Apple!
Cat. X17009 **$69**

MUSIC CARD
Three channel synthesiser can create a single polyphonic output or three monophonic outputs. Control of pitch and volume is possible. Up to three cards can be used at the one time. Complete with demonstration software.
Cat. X17011 **$99**

RGB CARD
True high definition colour for your Apple or compatible.
Cat. X17039 **$79**

P.A.L. COLOUR CARD
Get some colour into your games. Use your Apple or compatible on the second television. Has both UHF and composite video outputs. Fully adjustable so you can fine tune it for a crisp clean image.
Cat. X17025 **$95**

SUPER SERIAL CARD
No card does it better. Want to hook in to bulletin boards or mainframes? Turn your computer into a dumb terminal. That's right! This serial card comes complete with software.
Cat. X17035 **$129**

IBM* XT COMPATIBLE CARDS

NEW TURBO CARD!
Make your XT work as fast as an AT! (Up to 9 times faster)
Cat. X **$995**

Enhanced Graphics Card
Cat. X **$499**

High Resolution Colour/Graphic/Mono/Printer
Cat. X **$395**

640K Main Board
Cat. X18020 .... **$249**

Turbo Mainboard
Cat. X18030 .... **$295**

Mono Graphic Printer Card
Cat. X **$175**

Colour Graphic Display Card
Cat. X **$129**

384K Multifunction Card
(Includes cable, but not RAM)
Cat. X **$199**

Multi I/O and Disk Controller Card
(Includes cable)
Cat. X **$199**

Floppy Disk Controller Card
(2 drive capability)
Cat. X18005 .... **$79**

Floppy Disk Controller Card
(4 drive capability)
Cat. X **$99**

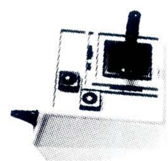
Parallel Printer Card
Cat. X18017 .... **$37.50**

RS232 Card
Cat. X18026 .... **$59.50**

Clock Card
Cat. X **$59.50**

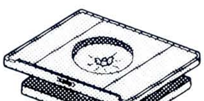
Games Adaptor Card
(2 joystick ports.)
Cat. X **$39.50**

Hard Disk Drive Card
Cat. X **$299**



JOYSTICK FOR IBM
Features Selectable "Spring centering" or "free floating". Electrical trim adjustments on both axis. 360 degree cursor control
Cat. C14205 .... **$49.95**

APPLE JOYSTICKS
Ideal for games or word processing. Fits most 6502 "compatible" computers.
Cat. C14200 .... **$39.95**

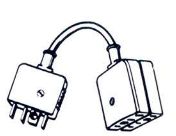


SWIVEL BASE
Make life easier with these quality, swivel and tilt bases, complete with rubber fittings!
Cat. D11100 .... **only $24.95**

10% OFF!!

IC STORAGE CASE
Electro static charge proof plastic IC case with conductive sponge. Dimensions: 75 x 130 x 19mm.
Cat. H10095 **NORMALLY $8.95**
SPECIAL, ONLY $7.95

DELUXE JOYSTICK
Suits Commodore 64, VIC-20, Atari, Sears, NEC PC-6001 computers or video games.
Cat. C14220 .... **$14.95**



TELECOMMUNICATION PLUG TO 2 SOCKETS.
Ideal for modem connections.
Cat. Y16014 .... **$12.95**

TEXTOOL SOCKETS
P17016 16 pin **$14.50**
P17024 24 pin **$14.50**
P17028 28 pin **$19.50**
P17040 40 pin **$22.50**

IC INSERTERS
14-16 pin T12187 .... **$8.95**
18-20 pin T12189 .... **$8.95**
24-28 pin T12191 .... **$9.95**
36-40 pin T12193 .... **$9.95**

APPLE IIe COMPATIBLE CARDS
80 Column/64K Card X17061 $89

NEW!!

D LINK NETWORK CARDS
Complete with software. Also runs PC-NET®. 1M/Bit per second data transfer rate via 2 wire link. Dedicated server not necessary. Up to 255 stations.
.... **$695**

TELEPHONE CURL CORD
- U.S. plug to U.S. plug
- Replacement hand set cord
- Length 4.5 metres

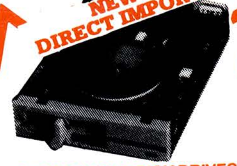
Cat. Y16023 .... **$7.95**

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

FREE POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

POSTAGE FOR ORDERS OVER $75 & UNDER 3kg!!

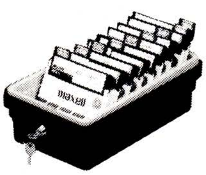
NEW! DIRECT IMPORT!



IBM* COMPATIBLE DISK DRIVES

Tired of paying up to 100% more for Japanese Disk Drives? We now have "direct import" Taiwanese disk drives at much lower prices!

Cat.No.	Description	Price
C11801	500K	$199
C11803	1 M/Byte	$239
C11805	1.6 M/Byte	$259

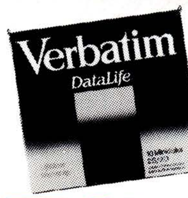


JUMBO 5¼" DISK STORAGE

If you've got lots disks, you'll appreciate the extra capacity of this disk storage unit when it comes to locating "that" disk!

Features...
- 100 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- 9 Dividers/spacers

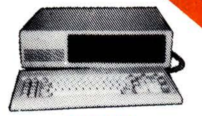
Cat. C16027 .... **only $24.95**



FLOPPY DISKS GALORE!!

All prices per 10 disk boxes!

Our Cat. Number	Product's Code	Description	1-9 Boxes	10+ Boxes
XIDEX 3½" DISKS				
C12600	3012-3000	S/S	$55.95	$53.95
			(Normally $75.00)	
C12602	3022-3000	D/S	$79.95	$75.95
			(Normally $109)	
XIDEX 5¼" DISKS				
C12401	5012-1000	S/S D/D 40 track	$29.95	$28.95
			(Normally $37.50)	
C12410	5022-1000	D/S D/D 40 track	$38.95	$36.95
			(Normally $47.50)	
VERBATIM 3½" DISKS				
C12610	MF350	S/S D/D 80 tracks/135 TPI	$54.95	$52.95
C12612	MF360	D/S D/D 80 tracks/135 TPI	$59.95	$55.95
VERBATIM 5¼" DATALIFE DISKS				
C12501	MD525-01	S/S D/D soft sector 40 track	$27.95	$26.95
			(Normally $44.95)	
C12504	MD550-01	D/S D/D	$34.95	$32.95
			(Normally $49.95)	
C12505	MD550-10	D/S D/D 10 sectors 40 tracks	$61.20	$56.95
C12507	MD577-01	S/S D/D soft sectors 80 tracks	$61.20	$56.95
C12510	MD557-01	D/S D/D soft sectors 80 tracks	$75.60	$68.95
VERBATIM 5¼" VALULIFE DISKS				
C12421		S/S D/D	$22.95	$21.95
C12421		D/S D/D	$29.95	$26.95
VERBATIM HIGH DENSITY 5¼" DISKS				
C12520	MD/HD	D/S H/D soft sector	$99.95	$89.95
			(Normally $109.95)	
VERBATIM 8" DISKS				
C12811	DD34-4001	D/S D/D	$63.60	$57.50
C12814	DD34-4026	D/S D/D	$66.00	$59.95
HEAD CLEANER DISKS				
C12551		5¼"	$14.95	$12.95
C12851		8"	$14.95	$12.95



IBM* COMPATIBLES from $895*

Assembled & Tested in Australia!

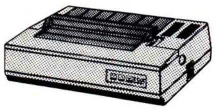
Incredible deals to suit everyone including special package deals!
*256K RAM, single drive, graphics, and disk controller cards. **$895**

256K RAM: Colour Graphics, Disk Controller Card, 1 parallel port, 2 disk drives and 3 months warranty. **only $1,195**

640K RAM: Colour graphics, Multifunction Card, Disk Controller Card, 2 serial and 1 parallel ports, 2 disk drives and 3 months warranty. **only $1,295**

APPLE* COMPATIBLE SLIMLINE DISK DRIVES

Japanese Chinon mechanism,
Cat. X19901 Normally $225
NOW $195
(*Apple is a registered trade mark.)



CANON A-40 PRINTER

- Serial Impact Dot Matrix
- 140 C.P.S
- Near Letter Quality Mode
- 1.4K Buffer

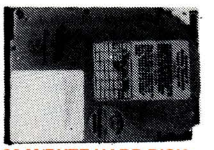
Cat. C20040 .... **$525**

5¼" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost!

Features...
- 70 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- Dividers/spacers

Cat. C16025 .... **only $24.95**



20 M/BYTE HARD DISK DRIVE FOR IBM* AND COMPATIBLES

Includes hard disk controller card.
Cat. X20010 .... **WAS $1,250**
SPECIAL, ONLY $995
*IBM is a registered trade mark.

SAVE! SAVE!

RS232 DATA SWITCH WITH TESTER

- 25 pin RS232 "D" connectors 2 in, 1 out or 1 in, 2 out.
- Ideal for 2 computers to one peripheral or 1 computer to 2 peripherals.
- No power required.
- Six dual coloured LED indicators showing certain flow status:
  T.D. Transmit Data
  R.D. Recieve Data
  R.T.S. Request To Send
  C.T.S. Clear To Send
  D.S.R. Data Set Ready
  D.T.R. Data Terminal Ready
- Housed in heavy duty metal cabinet.
- Size: 200(W)x68(H)x150(D)mm

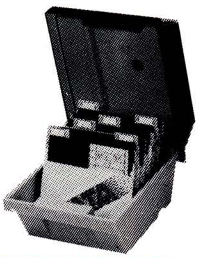
Cat. X19110 .... **Normally $149**
SPECIAL, ONLY $119

IBM* AT COMPATIBLE!

Assembled & Tested in Australia!

- 6 MHz
- 80286 CPU
- 8 slots
- 1 M/Byte main board
- 1.2 M/Byte Floppy disk drive
- 20 M/Byte Hard disk
- Colour graphics display card
- Floppy and Hard disk controller card
- Printer card and RS232
- 200W Power supply
- Keyboard
- Manual

All this for just $3,995
(Monitor not included)



5¼" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost!

Features...
- 50 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- Dividers/spacers

Cat. C16030 .... **only $19.95**

DIRECT IMPORT FLAT IDC RIBBON CABLE

	1-29m	30-59m	60+m
14 Way Cat. W12614	$1.90	$1.80	$1.70
16 Way Cat. W12616	$1.90	$1.80	$1.70
20 Way Cat. W12620	$2.50	$2.20	$2.00
24 Way Cat. W12624	$2.90	$2.70	$2.60
25 Way Cat. W12625	$3.20	$2.90	$2.70
26 Way Cat. W12626	$3.60	$3.10	$2.90
34 Way Cat. W12634	$3.90	$3.60	$3.40
36 Way Cat. W12636	$3.90	$3.60	$3.40
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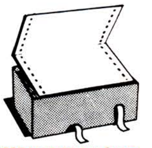

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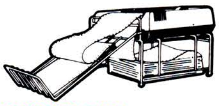

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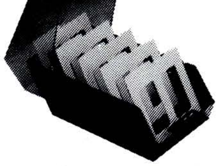

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2.0 or greater, and either two floppies or one hard and one floppy disk drive.

Installing Perspective is simple: insert disk A, type 'INSTALL' and a batch file does it all for you. There was no copy-protection on the review version, and its Australian distributors assure me none will be implemented on the final version.

Normally, with a good graphics package, it takes about 15 minutes to draw your first simple graph, two minutes to enter the data and about 13 minutes to find your way around the system sufficiently to draw a graph. With Pespective it takes about three minutes in all, and the finished graph is just one variation on a vast number of excellent three-dimensional graphs.

It is obvious from the moment you load this program that Perspective is a particularly well written piece of software. The user interface is a real joy to use, and proves that to make a piece of software easy to use you don't have to slavishly follow the Apple Macintosh WIMPs (Windows, Icons, Mice and Pull-down menus) interface.

Perspective's menu-driven system is totally graphics orientated; the main menu consists of a graphical representation of the function keys f1 to f5. Almost all the operations within Perspective are performed with these five function keys and the occasional use of other keys is restricted to entering data on the numeric keys, the space bar to remove the menu from a full screen picture and the cursor control keys.

Logically, the first thing you do when creating a graph is enter data. This is carried out via the data manager screen regardless of whether the data is entered directly at the keyboard or from a spreadsheet.

The data manager screen is divided into two parts, the worksheet and the status area. The worksheet takes up most of the screen and resembles a typical spreadsheet, as it is divided into cells that contain the data for graphing. However, there is no facility for even the simplest spreadsheet calculation. The status area takes up the top three lines of the screen and allows you to specify which cells will be labels and which will be plotted on the graph as well as a title or subtitle for the graph.

> *'Harvard is an attempt to provide everything you need to make a complete presentation.'*

The graph types in Perspective are broken down not by pie, bar and line, but by three-dimensional and two-dimensional graphs. Selecting the 3-D Graph types from the main menu results in the most impressive menu I've ever seen; the screen is broken down into 33 hexagons each containing a miniature three-dimensional picture of the different graph types. Pressing the space bar highlights each of the graphs in turn while hitting f1 will draw the required graph.

The bottom right-hand corner of the 3-D Graph types menu contains a familiar two-dimensional type graph. Selecting this takes you to a similar menu consisting of 15 two-dimensional graph types. The selection of two-dimensional graph types consists of the variations on the themes of bar graphs, pie charts, line graphs and point graphs.

All the usual graphs are available such as stacked bar, shaded line and best fit line. Of the more unusual options my favourite is Spectral Mapped Cells. The graph for this consists of a simple grid, each cell within the grid being filled with tiny dots; the higher the value for a particular cell, the more densely the dots are condensed. It's all very pretty but I've yet to find a practical use for it.

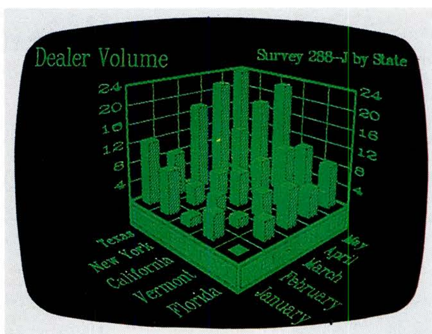
The options for customising two-dimensional graphs are shown in a five-function key graphical form at the bottom of the graph screen. From this menu you can change the colours and patterns used, explode or cut out a segment of a pie chart, switch rows with columns, adjust the bar width and spacing, and turn the grid lines on and off.

Perspective really comes into its own, however, when drawing three-dimensional graphs. All the other graphics programs I've seen which produce three-dimensional graphs use a 'false' perspective by drawing objects within lines that are parallel and, therefore, don't diminish with distance. This technique gives a three-dimensional appearance to what is essentially a two-dimensional bar graph; however, it is totally unable to represent three variables in three dimensions.

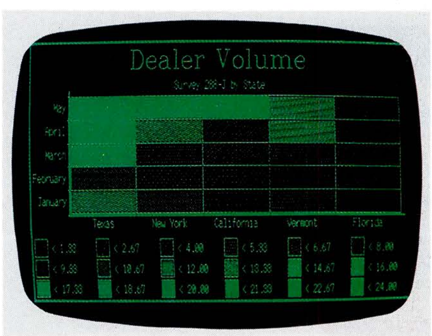
The Perspective programs follow Brunelleschi's (the 17th century mathematician attributed with the discovery of true perspective drawings) system whereby objects appear to diminish with distance until they reach a single common vanishing point. This gives a convincing appearance of reality and clearly shows data relationships of three interacting variables.

Perspective offers you 32 different three-dimensional graph types and 16 pre-set viewing angles, which means you can choose from up to 512 different screens when viewing your data — and that's before the customisation options are applied. I don't propose to discuss all the available graph types here, and suggest you look at the accompanying screenshot of the main menu to get a taste of what's available. Needless to say,

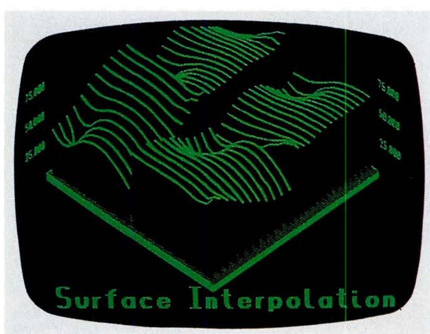
Perspective's main graph menu



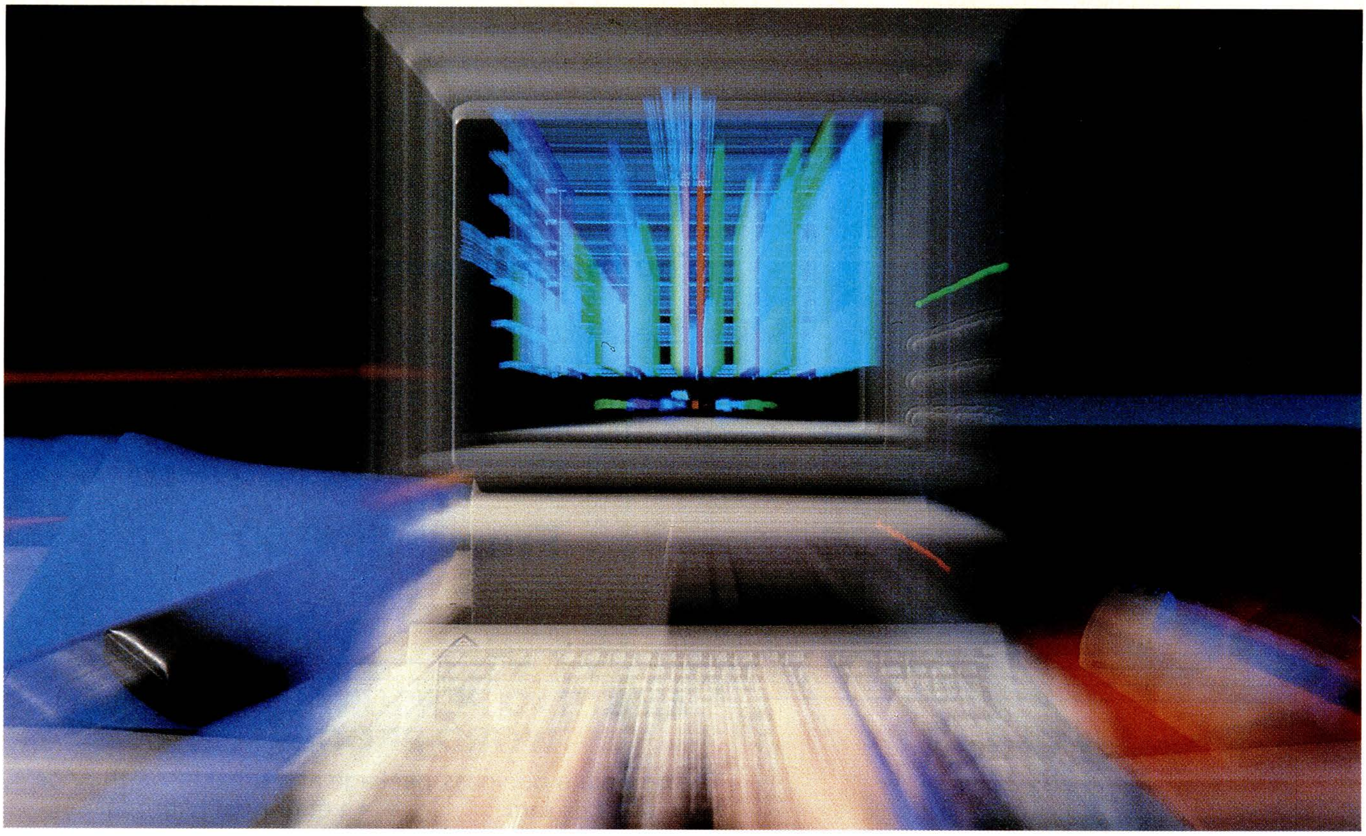
A true 3-D bar graph



A scatter chart



A 3-D surface



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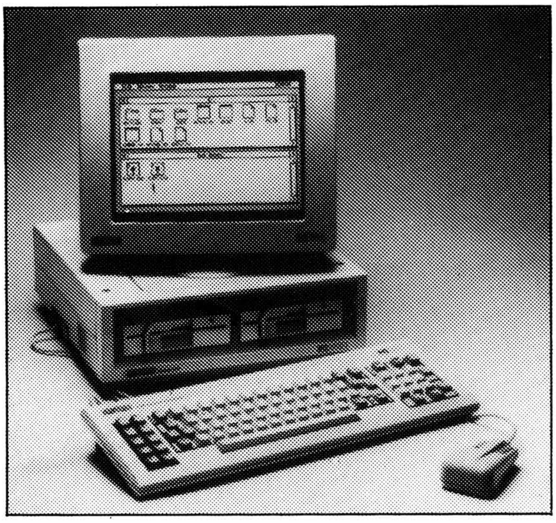

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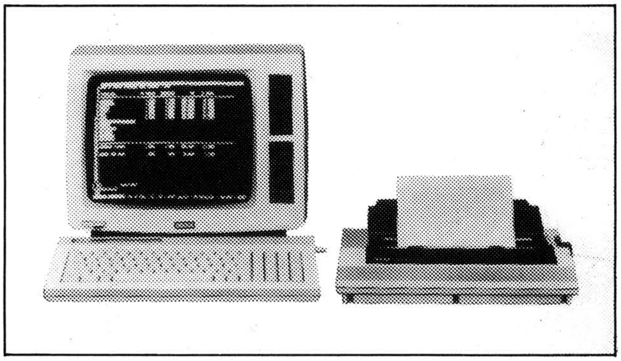

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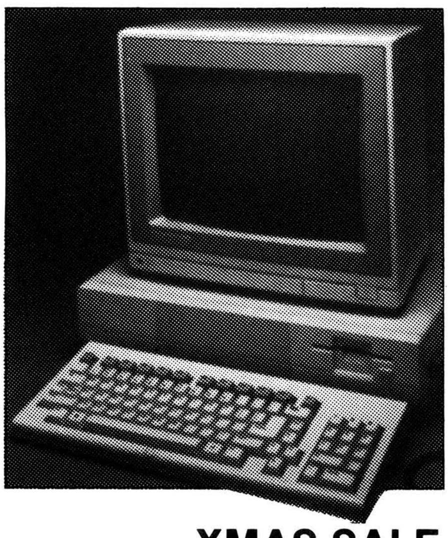

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they are all variations on the traditional two-dimensional graph types.

There is considerable customisation available for three-dimensional graphs broken into the two basic groups: viewing angle/distance and styling. Despite the complexity of these options, the user interface remains simple and is basically driven by five function keys.

Selecting the 'Custom Viewing Angle' from the main menu takes you to a menu from which you can adjust the angle, size or position of the current graph. The easiest way to understand these options is to imagine the graph as a cube, and, indeed, for certain operations Perspective actually reduces the graph to a box-like skeletal outline which you can then manipulate by rotating it in any plane, moving it towards and away from you, zooming in or out on it, panning in four directions and distorting it.

Styling covers all the editing options for everything inside the graph. There are fundamentally seven styling operations that can be performed. These are the selection of colours and patterns for the walls, floor, base, risers and background; adjusting the spacing between each cell of the grid; adjusting the base height; changing the row and column orientation; turning on the front corner outline; removing grid lines from the walls or floors; and tearing down the back walls.

One problem that occurs with the creation of three-dimensional graphs is that of labelling the axis. Each pre-set graph type and pre-set viewing angle comes with its own compatible label format, but because the labels are also drawn in true perspective, this makes the label totally illegible. An option called Label Manager attempts to rectify this problem by allowing you to change the size, spacing, slant and typeface of characters in order to get the best balance and positioning. A word of warning, however: although this option is useful, it can also result in dreadful looking graphs.

Perspective will accept data from Lotus 1-2-3, Multiplan and any application that produces ASCII files. As far as printing goes, Perspective supports a limited but well-selected number of printers or plotters, including a couple of laser printers.

The general style of the documentation was good but it has been written in such a way that it couldn't be easily used as a reference manual. I suggest a single read through the complete manual and then put it away; Perspective's ease of use makes it an ideal package to experiment with.

Prices

As this issue went to press, Imagineering announced a new release of Harvard Presentation Graphics (see box on this page for details) which will retail for $834. Imagineering is on (02) 662 4499.

Perspective costs $575 and is distributed by Megavision on (02) 957 5797.

Conclusion

Although both packages can perform the same function of turning a set of data into high quality graphs, they are really poles apart.

Harvard Presentation Graphics has a more general appeal. Creating a report or presentation is something almost everyone has to do at some time in their working life. If your occupation means you have to produce many reports, then I would strongly recommend Harvard as an aid to both the quality and speed at which such reports are produced.

Perspective is a specialist product that has absolutely no competitor in the production of three-dimensional graphs. I suspect there will be a number of users to whom it will be absolutely essential, particularly in scientific, mathematical and highly specialised business applications. However, the user-interface is so good that it may well appeal to less specialised users just because they will be able to create impressive graphs with little effort. END

New Harvard release

A new version of Harvard Presentation Graphics has just been announced with several new features including:

- The removal of a copy protection scheme
- User selectable symbols and data formats for a variety of markets (including Australia)
- An increase in the number of printers, plotters and film recorders. For example: Apple's LaserWriter, the HP7510A Film Recorder and the Lasergraphics MPS2000 Film Recorder
- The ability to select left, right or centre justification of chart annotations
- The presentation of one full-size, two half-size, three third-size or two quarter-size charts on each page.

Compaq DeskPro 386

The intention behind the design of the DeskPro 386 was a good one: all the benefits of a fast PC/AT-compatible and more memory contained in an 80386-based machine. Peter Jackson tests the reality of having such excellent features in one system.

The accelerating pace of microprocessor development gave Compaq some design problems over the last year, as 32-bit chips like Intel's 80386 emerged in sufficient quantities to make 32-bit micros economically feasible to build and sell. As the leader in the IBM-compatible market, and with some reputation as a maker of solid high-performance machinery, it was obvious that Compaq would build an 80386 machine. But at the same time, Compaq does not have the muscle to impose brand-new standards on the business micro world.

The result, the new DeskPro 386, shows very clearly the compromises that must be made in today's high-performance PC market.

The problem was not to do with wrestling the 32-bit processor into a system design, since the 80386 is only the latest development of a long-standing chip family including the 8088, 80186 and 80286, and the hardware and software requirements of these compatible processors are, by now, well understood by hardware designers.

No, the real problem was the IBM PC/PC-DOS standard set by IBM and Microsoft in 1981.

This standard dictates the basic hardware architecture, the expansion bus, the 640k limit on user memory, the maximum disk file size, and the monochrome and colour display standards of any machine that wants to muscle into the corporate market. But the 80386 offers designers and users the prospect of virtual memory, 32-bit data transfers, 32-bit addressing to get at four gigabytes (4096 megabytes) of RAM as easily as the PC gets at 640k, and blinding execution speeds thanks to 32-bit processing at 16MHz. The prospect of shackling that to the old PC architecture and operating system would horrify any reasonable system designers, and ought to drive them straight into the arms of the Motorola 68020 lobby.

But Compaq exists in the real world, and in the absence of any 32-bit product line or statement of direction from IBM, it has had to tread a narrow path. On the one hand, sticking to the old standard at the expense of performance would waste the potential of the chip and distress the users. On the other, unleashing the full power of the 32-bit processor would mean a proprietary machine with no software available, and no guarantee that IBM would decide to become Compaq-compatible when it launched its own range of 32-bit systems.

The design of the DeskPro 386, the first 32-bit micro from a major name, shows the results of this tightrope act very clearly. We shall see whether Compaq needs a safety net in due course.

But first, there is the 80386 chip itself, and the reasons for building any machine around it.

The main reasons are capacity and speed, since for once there is no argument — as there was with the 8088 — about whether the 80386 is really 8-bit, 16-bit or whatever. Everything on the 80386 is true 32-bit, including the data bus, the address bus, the chip's internal storage, and the arithmetic logic unit that does the actual processing work. The address bus size means that four gigabytes of RAM are directly accessible by the processor without any bank switching, while the data bus size means that data is called from memory in 32-bit lumps rather than the 8-bit lumps of the original 8088-based PC. And when that data gets into the chip, the 32-bit registers and the 32-bit logic unit means that it is processed fast. Add to that a standard clock speed of 16MHz against the 4.77MHz of the 8088 in the basic PC from IBM, or the 8MHz of the 80286 driving the AT/E, and it is obvious that the 80386 is a leap forward in microprocessor power.

But there is a lot more to the chip than that. It provides in hardware a lot of system functions that manufacturers are used to seeing in operating system software, and so makes it possible to run multi-tasking, virtual memory applications with enough performance to give small minicomputers like IBM's System/38 a run for their money.

However, when the 80386 is first powered-up or gets a reset, it enters the familiar 'real mode' of the 80286. In this mode, the 32-bit can only address one megabyte of memory using the traditional 64k segments, and looks

When in doubt, 'borrow' an idea from IBM. The 386's keyboard mimics the AT/E's enhanced layout

exactly like a 16MHz 80286 except for the fact that 32-bit operands can be used by the extended instruction set of the new chip. Naturally, any package that works on an AT will work in the 80386's real mode unless it checks the clock speed of the chips (as IBM's late-model AT BIOS does).

Changing one bit in a register flips the 80386 into 'protected mode', which gets its name from the fact that specific areas in the memory map can be separated off and write-protected as though they were some kind of disk drive. In protected mode, a whole new range of features opens up, just as it does on the 80286 under Unix or a lookalike such as Microsoft's Xenix.

First, the 80386 mimics the 80286 protected mode features, including the protection itself and the 16-bit instruction set. On top of that sit the specific 80386 features which give the chip its real power. The direct-addressing space goes up to four gigabytes, with no fuss about segments; it can be just one segment if required, rather than the 64k segment limit on the 80286. Also added are memory paging, protection for input and output as well as RAM areas, and the full 32-bit instruction set.

Most important for the future, though, is a third mode of the 80386 called 'virtual mode'. In this mode, real-mode programs can be run under the privilege levels set in protected mode — and if that is too many modes to follow, all it means is that programs written for the 8088, the 8086 or the real mode of the 80286 can be run in separate, protected areas of memory with the assurance that a program will never 'collide' with another by trying to use memory already in use.

This could not be done on the 80286, which has to be in real mode itself to run any real-mode programs at all. There is no such limitation on the 80386, and when a protected-mode operating system appears — perhaps Microsoft's long-awaited MS-DOS 5? — real multi-tasking with hardware assistance will be a reality. Included in the 80386 is a method of saving the state of an application and loading another in just 17 microseconds, speeding up the task switching that can bug multi-tasking if it needs to be done in the operating system software.

Similarly, such a new operating system could use the virtual memory features of the 80386, which allow more than 16,000 tasks, each with four gigabytes of memory split between RAM and fast disk. The total virtual memory capacity of the 80386 is thus greater than 64,000 gigabytes, a figure which gives us *APC*'s first mention of the ominous sounding 'terabytes'. The actual figure is 64 terabytes, which is 64×2^{40} bytes, or 70,368,744,177,664 bytes.

Unfortunately, there is no operating system that fits the bill as yet, not even current versions of Xenix (although Xenix 386 is promised 'in the first half of next year'). And if significant increases in performance are to be gained from the 80386 running under clapped-out real-mode MS-DOS 3.1, but retaining the ability to upgrade to the new multi-tasking virtual-memory operating systems that are inevitably on the way from Microsoft and others, some clever system architectural work is required. It is that job that Compaq has tried to do with the DeskPro 386.

Hardware

The DeskPro 386 looks exactly like its predecessor, the DeskPro 286 — or at least the review machine looked like it. Production machines outside the US will have a grey front panel and disk bezels rather than the black of the original DeskPro, which will give the machine a much less distinctive and IBM-like appearance. In the US only, the front panel stays black.

Apart from the 386 label, the security key and four storage-device slots are all the same as on the DeskPro. On the review machine, the four drives were two half-height floppies — one 1.2Mbyte and one 360k — in the top row above a new 40Mbytes cassette tape streamer and a half-height 5¼in Winchester drive holding 40Mbytes; a familiar configuration, apart from the increased capacities, from the top end of the DeskPro 286 line.

Opening the system unit in IBM PC style, but using Compaq's special unscrewing tools rather than the normal Phillips screwdriver, showed that the similarities with the earlier DeskPro stop at the outward appearance. The internal architecture of the machine has been changed to meet Compaq's design goals.

According to the company, the aim was to produce what the customers wanted; a machine that was compatible with the IBM PC/AT but with twice the speed, lots more memory, and had disks that were both big and fast. All those things are simple individually in 80386-based machines, but harder in one overall package.

Looking at the system board design after removing the lid shows one major new design feature instantly; there is no RAM on the main board. In fact the motherboard is tiny, partly because of this, looking more like the main board of a cheap XT clone than a 32-bit computer. In the usual hefty IBM-size case, shaped to take long expansion cards, the DeskPro 386 board barely fills half the base.

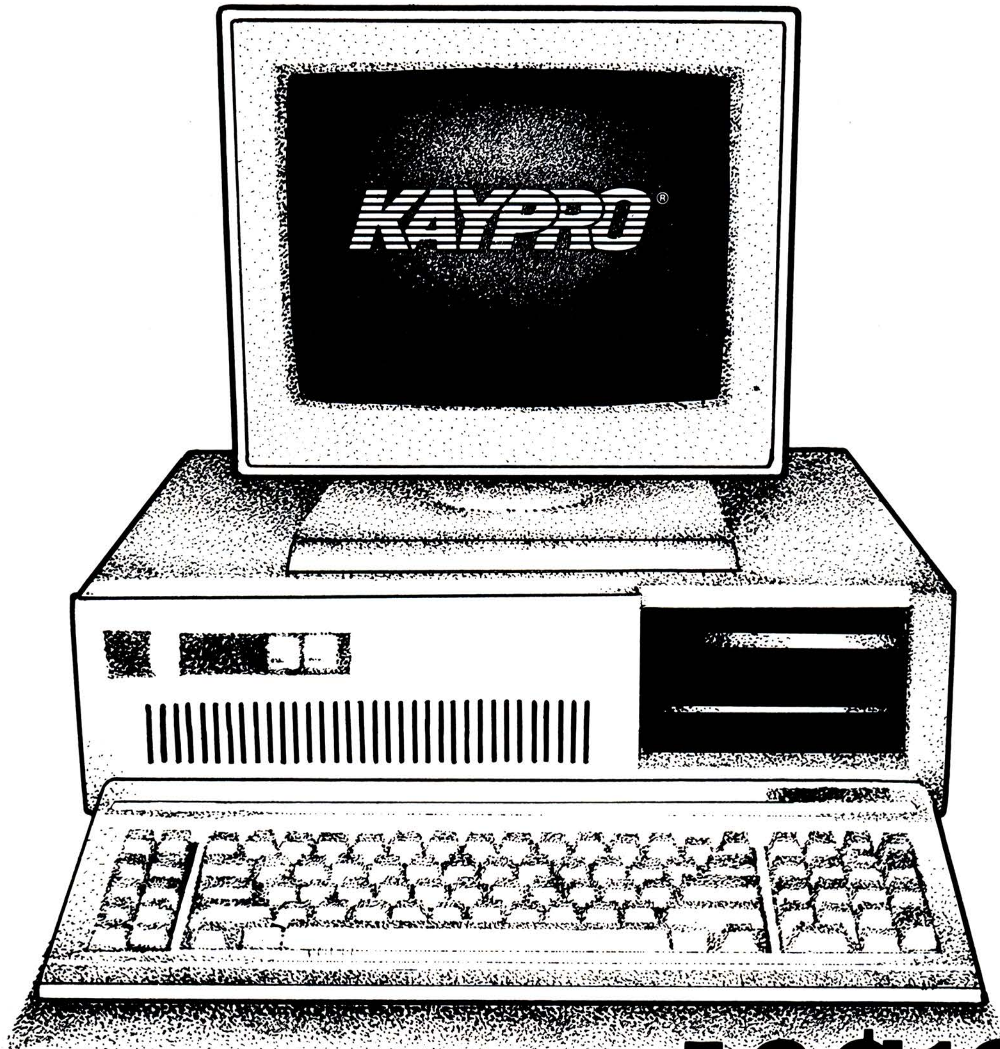
The system RAM is on a separate board plugged into a single 32-bit expansion slot on the left edge of the board, placed in such a way that the memory board fits along the inside of the casing. This slot is quite separate from the seven PC-style expansion slots at the other end of the board, although when expansion boards are put in those slots, they lie neatly parallel with the RAM board but in the other direction. There are seven expansion slots altogether, four extended 16-bit slots for AT boards and three for older 8-bit PC boards.

The 80386 chip itself, in a 152-pin square chip carrier, sits next to the RAM board slot and near a normally empty conventional chip socket designed for the 80287 maths co-processor; the 80287 was fitted in the review machine. In theory there is an 80387 maths processor designed to accompany the 80386, but there is no sign of a realease date for that chip yet. As with all Intel processor chips, the 80287 is compatible with the bigger 80386.

'It was interesting to watch GEM performing at the same speed as a Macintosh but in higher resolution and colour, and users of multi-tasking Microsoft Windows will want to lay hands on this machine.'

The system ROMs, totalling 128k, are placed over by the power supply connectors and the conventional expansion slots, and that completes the major features of the board. There are only about 85 chips on the motherboard in total.

The memory board in the 32-bit slot holds a minimum of one megabyte of RAM, made up of soldered 256kbit RAM chips and expandable to 2Mbytes just by plugging more chips in the empty sockets provided. However, as we will see later, this expansion can only be done in one lump of 1Mbyte, thanks to the memory architecture. An optional piggy-back board fits on this 'system memory board', and comes in two configurations: one is the same as the system memory board, with another 2Mbytes in 256kbit chips, and the other



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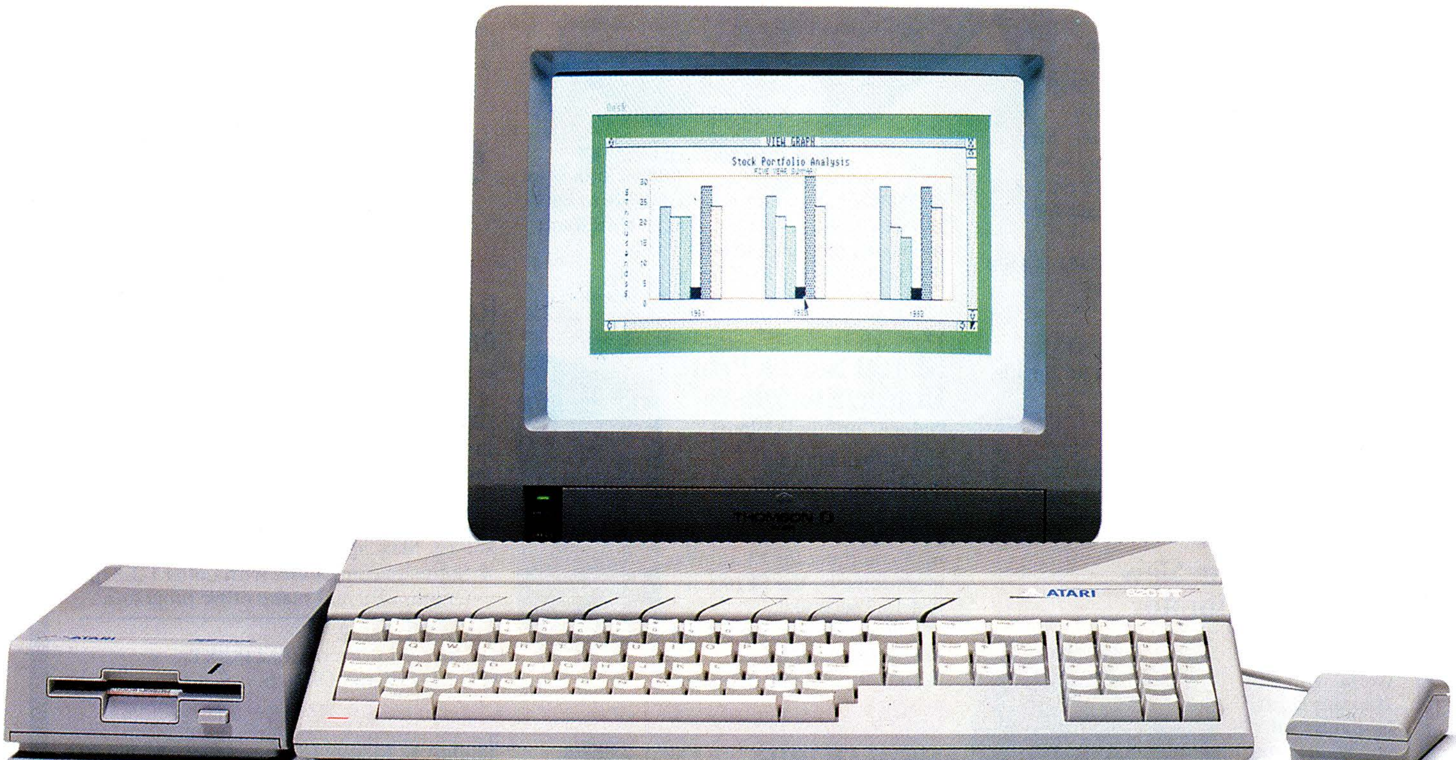

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provides 8Mbytes using the same number of the 1Mbit chips that are now starting to emerge in volume from the Japanese silicon foundries.

This way of handling system RAM means that 10Mbytes can be installed in the box without using any expansion slots at all, and also puts a tentative toe in the water of standard-setting. Compaq will freely give details of the 80-pin 32-bit bus used in its memory slot to anyone who wants it, and nobody would be happier than Compaq if dozens of third-party companies leapt forward to build 32-bit add-on boards to plug into the piggy-back connectors on the memory board.

In fact, using more conventional big-memory boards like Intel's Above Board or AST's RAMpage in the more conventional PC-style expansion slots, Compaq claims a maximum RAM capacity of 16Mbytes.

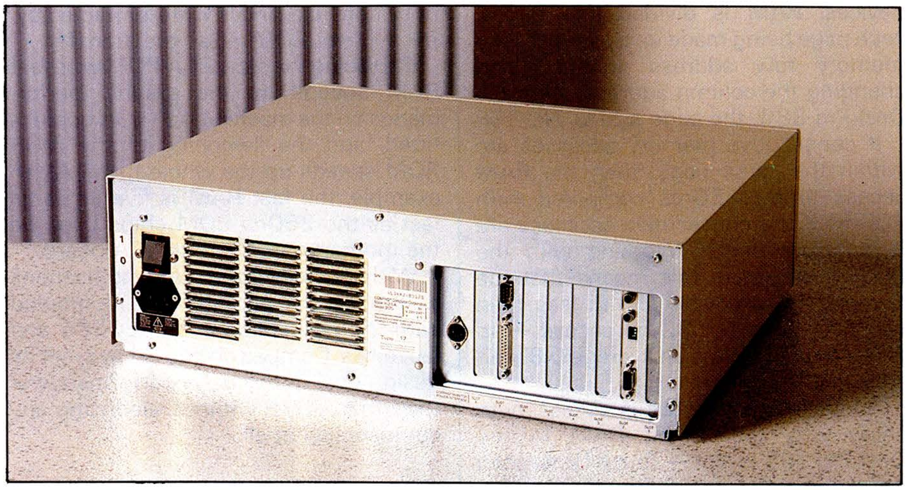
The floppy disk drives have no surprises to them; the basic system comes with a single 1.2Mbyte floppy drive, and in the review machine this had been supplemented with an optional 360k drive.

The hard disk drive options, however, are different. There are two hard disks in the Compaq line, one with 40Mbytes of storage and one with 130Mbytes to meet the customers' researched demands for more disk space. To get high speed, Compaq has used an integrated controller for the 40Mbytes drive, and an even faster ESDI standard external controller for the 130Mbytes unit. With the 40Mb drive the access time is promised to be less than 30ms, while on the larger drive it is less than 25ms — and Compaq claims that in real life it has a 17ms average access time in tests.

Importantly, the floppy controller, as well as the tape streamer control, are built onto the input/output board included with the system, along with one 25-pin parallel port and one nine-pin serial port just like the AT. Therefore the minimum storage configuration of the DeskPro 386 does not take up any expansion slots beyond the one used by his version. Choosing the 130Mbytes drive also cuts down the storage options, since it is a full-height drive compared with the 40Mbyte's half-height.

The only other board in the review box was Compaq's new Enhanced Graphics Adaptor (EGA) board, which comes with its own 256k of display memory. This board, built to Compaq's own design rather than bought in from one of the many third party makers of EGA-compatible boards, gives the usual EGA resolution of 640 × 350 pixels in 16 colours selected from a palette of 64.

The 386 provides four slots in one unit, including a 40Mbyte tape streamer



Input/output is via expansion boards, but 32-bit expansion is internal only

But to maintain compatibility with earlier Compaq and IBM models, the board can also handle the unusual Compaq dual-mode text-and-graphics monitor format of 720 × 350 pixels in monochrome.

To go with the EGA board, there is also a new 13in RGB colour monitor with built-in tilt and swivel. Both monitor and board will be available to existing DeskPro users alongside Compaq's existing green and amber monochrome screens, and the system package prices now unbundle the monitor since there is a choice of colour or not.

The keyboard on the review machine was a new Compaq model mimicking the layout of IBM's latest enhanced keyboard, launched with the AT/E. This has a separate cursor key cluster and 12 function keys rather than the normal 10, a change made by IBM to improve compatibility with its minicomputer and mainframe terminal keyboards. Users who, for some reason, prefer to have a combined cursor and numeric keypad can still use the old DeskPro keyboard with the new machine.

So far, so commonplace. Apart from the unusual placing of the system RAM, this could just be another fast AT clone. The RAM organisation, however, is crucial to getting the required high performance out of the system with the inadequate operating system software that Microsoft provides as MS-DOS 3.1

System architecture

As we have seen, Compaq's aim was to maintain compatibility with software and add-on hardware aimed at the IBM PC and AT markets, while providing twice the performance of IBM's fastest AT. The fast processor speed and fast hard disk drives can go some way towards that, but not far enough.

So, the DeskPro 386 is split into two functionally separate parts. On one side of an invisible divide is the processor and its 32-bit slotted RAM; on the other is an

8MHz AT clone. All the data and address bus lines to and from the expansion slots — bar the 32-bit one — run at 8MHz rather than the 80386's 16MHz clock speed, to cut out any speed problems with third party boards.

However, on the 32-bit side of the machine, things are different. The RAM organisation has been set up to work with the efficient 32-bit pre-fetch mechanism of the 80386; this mechanism gets data from memory before the processor actually needs it to work on, speeding things up since the data needed is always right there on the chip rather than miles away in main RAM.

Data is transferred from the RAM chips to the 80386 in 32-bit words, and transfer speed is improved by organising the RAM as an array of static-column devices. RAM is divided into pages, each page being made up by keeping the memory row address constant and changing the column address. With the DeskPro 386, the page size is 2k.

If consecutive memory accesses are within the same page, then the RAM access time is 50ms compared with 100ms if the consecutive accesses are in different pages. Working with the 80386 pre-fetch, this means that the Compaq RAM operates with less than one wait state per 32-bit access — in fact, Compaq claims an average 0.8 wait state.

All that technical stuff is necessary to show why the 32-bit RAM in the DeskPro 386 is *fast* — much faster than the speed of the individual memory chips would indicate. That extra RAM speed increases the performance of the machine even further above that of the 8MHz AT.

Moreover, if memory above 1Mbyte is installed in the 32-bit slot, it can act like Lotus-Intel-Microsoft expanded memory using software jointly developed by Compaq and Microsoft, and called the Compaq Expanded Memory Manager (CEMM). The speed of the RAM means that the L-I-M bank switching is much faster than it is in conventional AboveBoard type expanded memory. Real Above Boards or RAMpage boards can be plugged into the ordinary expansion slots and handled by CEMM as well.

But that was still not enough speed. So at boot-up time, the system ROMs check to see whether the ROM on the EGA board is present; if it is, the system copies itself and the EGA ROM up into fast 32-bit RAM between 640k and 1Mbyte and runs from there, mapping back down to the appointed place in the memory map so applications can find the ROM in the RAM. The area of RAM above 640k used as 'ROM' is reserved for system use, and is write-protected by the system ROM after the transfer.

Replacing the slow EGA ROM with fast RAM speeds up the graphic performance on the machine if an EGA board is fitted, and the switching of the BIOS ROM speeds up the whole thing. As an example, the fast RAM is five times as fast as the 250ns ROM chips used on the motherboard and the EGA board.

With all these speed-up modifications to the system architecture, combined with the raw speed of the 80386 and fast disks, Compaq claims to have met its design goal of twice the performance of the 8MHz AT/E without sacrificing any compatibility at all.

In perspective

It is difficult to compare the DeskPro 386 with anything else on the market, since it is the first of the 80386 machines that is not trying to do anything particularly special. For example Corvus has launched a $US15,000 file server for its network products.

But Compaq is positioning the DeskPro 386 first of all as a single power-user's PC, although it acknowledges that it would make a fine file server for something like a dozen PC clones, given the right network hardware and applications software.

It is hard to guess how many power users there are who need twice the performance of an 8MHz AT. But Compaq claims that 29 per cent of its users are responsible for 72 per cent of the cash orders, and it is those users who were asked for the specification of their dream machine.

Compaq has been careful not to cut itself off from full compatibility with the IBM PC line, while building-in an architecture that can take advantage of the improved operating system software that *must* come sooner rather than later.

System software

In the absence of a protected-mode multi-tasking memory operating system, the DeskPro 386 comes with MS-DOS 3.1 as its main piece of system software and Xenix System V/286 — using the 80386 in its 80286 mode — as an option.

A few additions have been made to MS-DOS besides the CEMM driver; in particular, a speed command has been included to slug the 80386 speed down if particular applications demand it. Typing 'spe-fast' cuts the system speed down to 8MHz, while typing 'spe-high' turns it back up to 16MHz again. The speed can also be cut to 6MHz if required, since some early AT software either checks the processor speed before running or uses the speed as part of a copy protection scheme.

Another step forward is the tape streamer support. With the new 40-Mbytes streamer now available, selective back-ups of individual files or directories can be made without worrying about overwriting the next file along. The streamer also allows back-up of more than 40Mbytes across more than one tape, and will read tapes from

Technical specifications

Processor:	Intel 80386, 16MHz; socket for 80287 maths co-processor
RAM:	1Mbyte, expandable to 10Mbytes in one slot
ROM;	128k
Mass storage:	Half-height 1.2Mbyte 5¼in floppy drive; half-height 40Mbyte Winchester drive
Storage options:	Full-height 130Mbyte Winchester; 360k floppy; 40Mbyte intelligent tape streamer
Display:	Compaq dual-mode monochrome monitor, in green or amber; EGA colour monitor and display card, resolution 720 × 350 in 16 colours.
Keyboards:	Old-style IBM AT-compatible 85 keys; new-style IBM enhanced, 101 keys
Standard interfaces:	Centronics parallel port, 25-pin IBM PC connector; RS232 serial port, nine-pin D-type connector
Expansion slots:	One 32-bit, piggy-backed on RAM board; four AT-style 8/16-bit; three PC-style 8-bit; one slot taken in basic 40Mbyte configuration
Operating systems:	MS-DOS 3.1, with Compaq BIOS and CEMM memory manager; Xenix System V/286

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Compaq's earlier 10Mbytes streamer but not write them.

Apart from that we are in familiar territory with MS-DOS, and there is little more to add.

For the future, until Microsoft produces a new version of MS-DOS to drive the 80386 properly, the only new operating system for the machine will be Xenix System V/386. Compaq and Microsoft are working on the product now for release in the first half of next year, and claim that it will be the first operating system to use 32-bit program code.

Gold Hill, with its Golden Common Lisp language, Information Builders, Aplix, and Cobol specialist Ryan-McFarland are all working with the Microsoft Toolkit to produce 32-bit applications for Xenix System V/386 and the DeskPro 386.

According to Microsoft, the new Xenix will support the large linear RAM space and demand paging of the 80386, and allow more efficient use of memory and hard disk capacity for large applications as well as provide separate protected memory areas for secure multi-user applications. It will also let users get at the full 14Mbytes of RAM and four gigabytes of virtual address space of the Compaq machine.

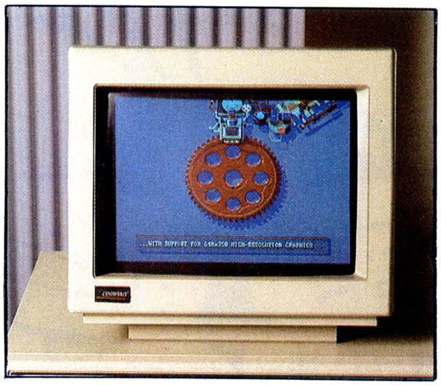
Applications software

Compaq claims that 20 major software and hardware developers have completed compatibility tests on the DeskPro 386, and have concluded that all their products work. A leaflet listing 160 or so products that Compaq has tested is also included with the machine.

The developers include Ansa Software, with the Paradox database; Ashton-Tate, with dBaseIII Plus, Framework II, Multimate 3.3 and Advantage; Autodesk with AutoCAD; Borland, with its full range; DCA, with its range of communications cards including IRMA; Lotus with its full range; Microstuf with its full range, with the proviso that one must run at 6MHz or 8MHz speed; and Quadram with several boards including Quadmeg AT, Quadcolor II, QuadEGA+.

In a rather more modest test of compatibility, I installed Digital Research's Concurrent DOS and GEM, the AutoCAD design package, Word Perfect, Pink Software's TurboCAD, and Microsoft's C Compiler Version 3.0.

Most of them ran flawlessly and fast on the DeskPro 386, particularly graphics-based packages like GEM Draw, GEM WordChart, and AutoCAD. The sieve program included with Microsoft C found 1899 primes almost



Compaq's first colour monitor running a high-res graphics demo

instantaneously, while Word Perfect did not act much differently than it does on a 4.77MHz 8088-based PC, since it depends on user input so much.

The problem came with Concurrent DOS, which could not find the DeskPro's hard disk drive. Compaq says that Digital Research is aware of the problem with Concurrent and that a fix would be made.

A version of Borland's SideKick also crashed the machine, seeming to have some trouble with the EGA card. But that was an early version that had no EGA option on the installation menu, and if Borland says that SideKick works with the DeskPro 386 now, I would be inclined to believe it.

The code compatibility of the 80386 with the 80286 and even the 8088 means that, in theory, any PC or AT package should work with the 80386. As ever there is a gulf between theory and practice, and it is worth making sure that the package you want to use is on the approved list, or check with the publisher, before laying down cash for the machine.

As a very rough test of speed besides the Benchmarks an AutoCAD drawing was plotted at full speed and once with the speed cut to 8MHz, but both using the 80287. On average, the 8MHz plot took just under twice as long as the full-speed one.

In use

The DeskPro 386 performed quickly and well throughout the test period. The keyboard has been improved, getting rid of the unpleasant squashy feeling on the earlier DeskPro models, and the colour monitor, combined with the EGA board, is an impressive piece of work. The colours are bright, and the switching of the EGA ROM into fast 32-bit RAM speeds up the EGA's normally sluggish performance.

It was interesting to watch GEM

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performing at last at the same speed as a Macintosh but in higher resolution and colour, and users of multi-tasking Microsoft Windows will want to lay hands on this machine.

Apart from the problem with Concurrent, there were no glitches or crashes, and for such an early machine — still with the black front panel! — it looked like a very solid product indeed.

Prices

Unusually for Compaq, the DeskPro 386 is aggressively priced, with 1Mbyte of RAM, one 1.2Mbytes floppy drive, a real-time clock, serial and parallel ports, and the 40Mbytes Winchester, the box costs $14,250 including a choice of keyboard but minus monitor.

With the 130Mbytes Winchester, the price goes up to $18,947. Option prices include $7070 for the four to eight megabyte 32-bit RAM expansion board, a high price thanks to the scarcity of 1Mbit chips; $503 for the 360k floppy drive, $1397 for the EGA board and $1397 for the monitor; $838 for the 80287 chip; and an aggressive $1706 for the intelligent 40Mbytes tape streamer.

Benchmarks

Old:		New:	
BM1	0.15	Intmath	1.0
BM2	0.56	Realmath	0.96
BM3	1.45	Triglog	3.85
BM4	1.45	Textscrn	25.50
BM5	1.55	Grafscrn	4.8
BM6	2.65	Store	2.6
BM7	4.05		
BM8	4.60		
Average	2.06		

All timings in seconds. For a full listing of the Benchmark programs, see End Zone.

Conclusion

It is hard to escape the feeling that Compaq has made the best of a bad job with the DeskPro 386. Given an 80386 and unlimited freedom, a competent microprocessor engineer would not have come up with this design.

But given the constraints of the market-place and the operating system, Compaq has worked hard on an innovatory architecture that sets almost no new standards, but which gets better performance than expected out of existing standards.

If it gets a real operating system, and drops all this L-I-M bank switching, 32Mbytes file size limits, and 640k main RAM barrier, the DeskPro 386 should give any new IBM PC a run for its money. And it stands a fair chance of a crack at the System/38 as well.

At press time, Compaq announced a 70Mbytes Winchester version of the 386. It will retail for $16050 — Ed.

END

WHO IS HAL?

SCREENTEST

First Choice

Specifically designed for the new breed of IBM clone users, First Choice is an inexpensive, easy-to-use integrated package which is well aware of its limitations. John Donaldson put it through its paces.

Whenever I think of an integrated package such as Framework or Symphony, I almost have a nervous breakdown on the spot. It is very refreshing, therefore, to see a new integrated package which is a) very cheap and b) knows its limitations. First Choice from pfs software is designed as an easy-to-use integrated package based around a central word processor. It is specifically designed for the new breed of IBM clone users who have bought a cheap clone and who go green at the thought of spending a fortune on software.

First Choice is designed to run on the IBM PC or any compatible. The only possible problem you could face is that because it is designed to work solely in the RAM of your machine, you need to have at least 256k of memory installed in your machine. Obviously, the more memory you have, the more you can do.

The review software consisted of a pre-release version of First Choice, so it was supplied without any packaging on ordinary non copy-protected disks with a photocopy of the manuals. I would expect the finished version of the packaging to be far more professional.

Installation was extremely straightforward and simply involved copying the files from the two distribution disks onto the hard disk. If you are using a twin floppy system, the manual includes clear instructions on how to back up the master disks. One interesting point is that the manual also includes instructions on how to copy the files onto the new IBM 3½in disks which are used on the PC Convertible.

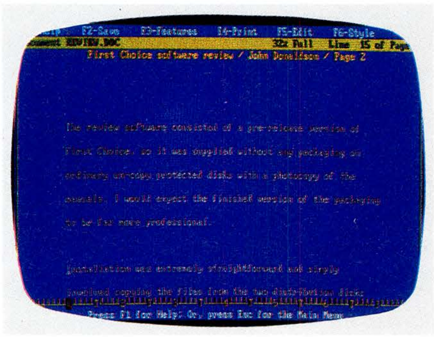
When you have copied your First Choice files, you can run the program simply by typing "FIRST". The software is set up originally to assume that it is running on a monochrome IBM PC with a general purpose ASCII printer and a Hayes-compatible modem.

When you first run the software, you can select the 'Set Up Equipment' option from the main menu. This allows you to tell the program whether you are using a colour or black and white screen and choose a printer or modem from the list of available drivers. When you have done this, First Choice will remember your new settings every time you run it.

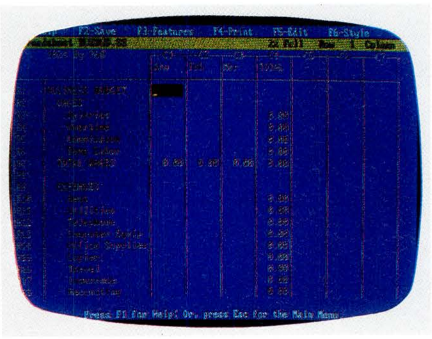
In use

When you run the program, you are greeted by the top level menu. Its exact look will vary according to what type of IBM display you are using. I used an Enhanced Graphics Adaptor and the menu came up in a very tasteful combination of black, light blue, dark blue, pink and a very fetching aquamarine. If you are using a monochrome monitor, however, these delights are not to be, and you have to put up with black and white. Ah well.

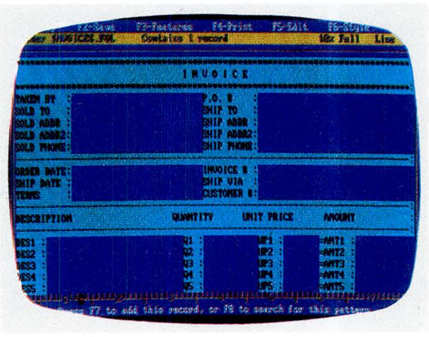
Whatever the menu looks like, the contents are the same. You are presented with a list of eight options which allow you to use the word processor, the database, create a report,



The word processor is easy to use . . .

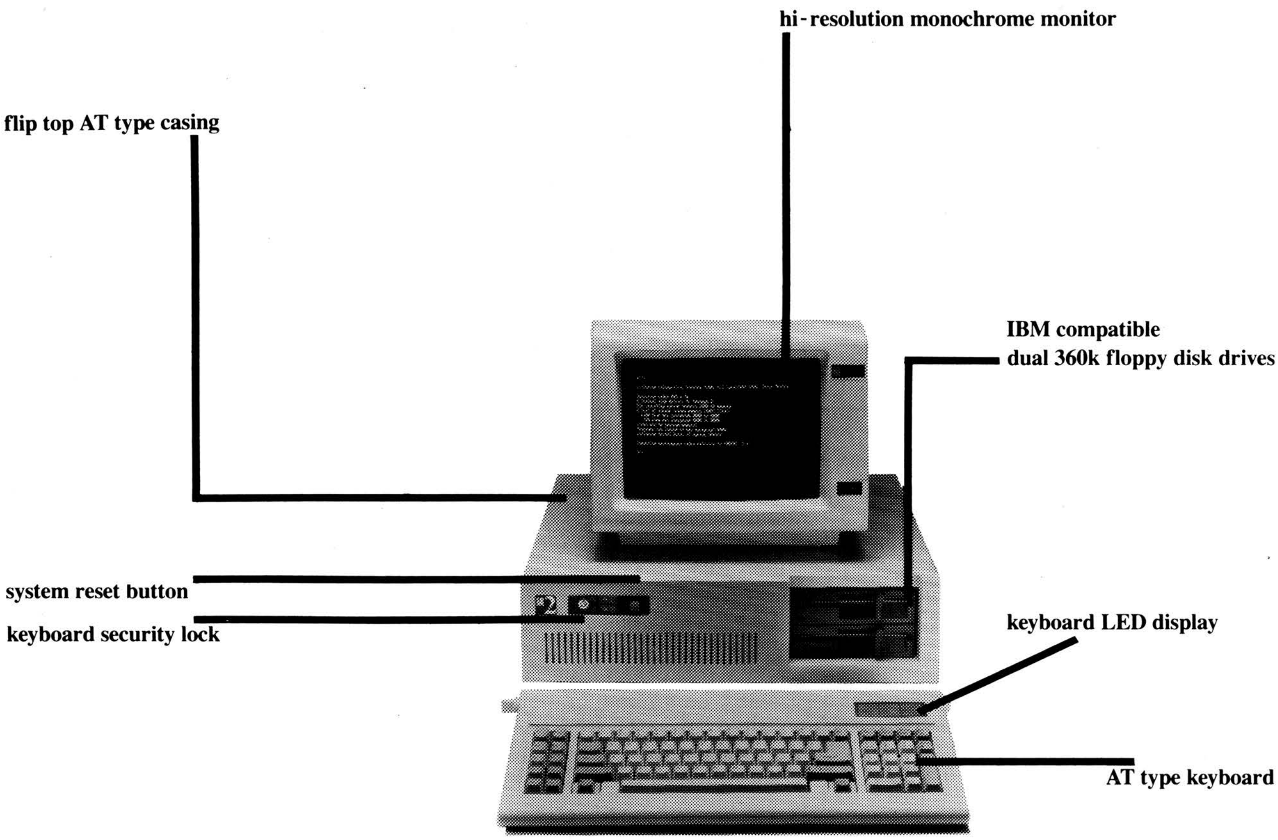


The spreadsheet is less easy to use . . .



And the database is very basic . . .

meet HAL



HAL 2 Standard Configuration

Processor: Intel 8088-2 4.77/8MHz (switchable)	**Power supply:** 150w power supply
Memory: 640k, all IC in sockets	**Case:** flip top AT type
Storage: dual 360k FDD	**Monitor:** TTL monochrome/color
Monitor controller: Hercules/color	**Operating system:** fully licensed MS-DOS
Multi I/O: parallel, serial (2nd optional) and games ports,	**Warranty:** 12 months
real time clock, disk drive controller	**20MB Winchester (optional):** Tandon
Keyboard: 84 keys with LED indicator (AT type)	

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plan a spreadsheet, retrieve a file from disk, connect to another computer, change the settings for the program or exit to DOS. You select an option either by typing the appropriate number on the keyboard, or by using the cursor keys and pressing return.

Word processor

The whole thrust of First Choice is centred around the word processor, pfs believes (rightly in my view) that the word processor will be the most heavily used part of First Choice, so there are more features in this section.

The word processor also forms the model for the user-interface for the other sections of the package. So as soon as you have mastered the word processor, the other sections will be no problem, because they look and behave in much the same way.

When I first tried the word processor, I was impressed with how well the screen was laid out. The display is made up of five main parts. The top line contains the pull-down menus which are used to control the program. The next line down displays the current document name, the line and page number of the current cursor position and a figure to tell you how much memory you have free.

I found that on the review machine with 640k of RAM installed, I ran out of memory after about 25 single-spaced pages. The middle of the screen is initially blank and is used to display the contents of the document you are editing. Finally, the next to bottom line displays the ruler along with the current margin and tab settings, and the bottom line instructs you to press F1 for help or ESCape to get out of the word processor.

This general layout is followed for all the modules of First Choice as well as the word processor. This is good because you know where the general commands in the pull-down menu will be. You also know that F1 will always get you context-sensitive help and that ESCape will always get you out of whatever you are doing.

The word processor uses six pull-down menus which are selected by hitting functions keys F2 to F6 (f1 gets Help, remember?). From left to right they are labelled 'Save', 'Features', 'Print', 'Edit' and 'Style'. Once you have hit a function key to select a pull-down menu, a set of sub-menus is displayed on the screen. You can then select the function you want either by typing its number or by using the cursor keys to highlight the function name and pressing Return.

To take each of the main menu options in turn, Save gives you four options; Save a copy of the current document, Save selected text only, Merge another document and Erase a file. These options make use of First Choice's 'Directory Assistant' which makes it very easy to select files.

The Merge Print option allows you to merge other documents into the current one. This can be very useful for creating standard letters by merging together different standard paragraphs. Another use could be to include, say, a small spreadsheet file in a word-processed document.

One nice touch is that First Choice will automatically save an ASCII version of your file if you use an .ASC extension on the filename. So, for example, MYFILE.ASC will be stored in ASCII.

The Features menu has a total of six sub-options: Find and Replace, Check Spelling, Set Tabs and Indent, Set Margins and Page Length, Set Bookmark and Find Bookmark.

Like the Merge Print feature, the spelling checker is another standard feature which I am very pleased to see in such a low-priced product. First Choice is supplied with an 85,000 word dictionary against which it checks your words of wisdom. Both American and British versions of the dictionary have been produced; the British version is being distributed in Australia.

The Set Margins and Page Length option make it very easy to change the size of the document and also allows you to insert up to two lines of header and footer text. Page numbers can be automatically inserted by using the *PAGE* command, although it is not possible to alter the position of the number of odd and even pages.

The two Bookmark options allow you to set up to six tags which the system jumps straight to. Although this can be helpful in long documents, the advantage of this is that it is not limited to the word processor. You could set, say, one bookmark at the front of a word processor document and another in the middle of a spreadsheet model, and use the Find Bookmark option to jump between them.

The Print section has three sub-menus; Print this document, Print selected text only and Print form letters or labels. The last option is by far the most interesting because it allows you to create a form letter and then merge it with data from the database to produce customised letters, circulars, and so on.

The Edit section has no less than nine sub-menus; luckily most of them are self-explanatory. These are: Select text, Cut out selected text, Copy selected text to Clipboard, Move selected text to Clipboard, Paste from Clipboard, Insert a blank line, Erase this line, Erase this word and Erase this document.

For any block operations involving the copying, moving or deletion of a chunk of text, First Choice uses the concept of a clipboard. This idea was made popular by the Apple Macintosh and involves the temporary storage of a piece of text until you decide what to do with it and 'paste' it back into the document.

Once you have got used to using the commands in the Edit menu, you will find that it is possible to use special keystrokes to avoid the tedium of having to go to the menu and select a sub-option. So, for example, instead of selecting 'Erase this word' from the Edit menu, you could simply press Alt W to delete a word.

The final pull-down menu, Style, also has nine sub-options related to the look of your document. These are: Boldface, Underline, Italics, Superscript, Subscript, Erase style, Single space, Double space and Centre.

In these terms First Choice is about as WYSIWYG (What You See Is What You Get) as it is possible to be on an IBM. I must say that I found the First Choice word processor very simple to use. One of the nicest features I found was the ability to embed printer control codes within the document simply by surrounding the code with asterisks. This can be very useful if you are trying to do something flash with your printer.

One of my major annoyances was that every time you start the word processor, it defaults to overtype mode instead of the insert mode which I am more used to. Invariably I only remembered this after I had destroyed some of my text.

Most of my other problems centred around bugs in the pre-release version of the software. These ranged from bookmark features which did not work properly to some more serious bugs in the cut and paste routines. This resulted in lost text, wrong formatting or a hung system. Hopefully the release versions of the software will not be afflicted in this way.

Database

The database is probably the least powerful of the functions provided within First Choice. I have a feeling that most people will only use it to maintain lists of data to merge print into the word processor.

To create a database, you simply design the input screen using the cursor keys to move about and then type the field names followed by a colon, '(:)', to tell the program that this is a field name. The database screen looks exactly the

same as the word processor screen — even the spelling checker is still there.

Once you have completed your form design, you hit F10 and the system memorises the form. As soon as this is done you can start entering data using the Tab key to move from field to field. When the form is complete you press F7 to add the record. All fields are freeform.

Records can be retrieved by typing the words or numbers you are searching for into the appropriate field and hitting the F8 key. Partial matches using '..' and '?' are possible as are relative matches using the logical operators '<', '>' and '='.

The one thing to be said for the database is that it is very easy to use. To be fair, pfs doesn't even call it a database and prefers to call it a file manager. I suppose this is a fair assessment of what it does.

Report generator

The report generator is actually more powerful than the database it supports. Using the report generator you can take data from the database and play lots of neat tricks with it.

For a start you can select which fields from the database you are going to use for the report. You can then sort the data in ascending or descending order, add it up and produce sub-totals and averages. You can even create derived columns in the report by performing logical operations on other columns, so you could say, for example, that column three equals column one plus column two.

Spreadsheet

Of all the functions of First Choice, the spreadsheet is the least easy to use. For a start, the design of the screen looks slightly different from the other modules.

This is mainly because of the spreadsheet matrix displayed in the centre of the screen. For some reason First Choice only uses half of the usual grid to display the spreadsheet, so where most packages would have vertical lines to separate the columns and horizontal lines to separate the rows, First Choice only separates the columns. I found that this makes it difficult to tell exactly which row some numbers are in.

One particularly nice feature of the spreadsheet is that it displays the maximum spreadsheet size you can use on your machine. On the review machine with 640k of RAM, this was 1024 x 768 cells. Obviously this varies according to how much RAM you have installed.

Typing a value into the spreadsheet is simply a question of moving to the desired cell and typing the number. Entering a formula, however, is more complicated.

The majority of popular spreadsheet programs such as Lotus 1-2-3 and SuperClac allow you to enter formulae into cells in much the same way as you type a number. However, with First Choice you have to go to the cell and then select 'Type or Edit Cell Formula' from the Features pull-down menu. This opens a window into which you can type your formula. It all seems like hard work to me.

First Choice supports a fairly standard range of mathematical and statistical formulae such as Sin, Cos, Tan, Standard Deviation, and so on, but it doesn't amount to much more than you would get on a good scientific calculator.

One nice feature, however, is that it does support the IF . . . THEN . . . ELSE control structure along with the 'AND', 'OR' and 'NOT' logical operators.

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Directory assistant

The Directory Assistant is First Choice's way of shielding the users from the horrors of the DOS command line. It is automatically called up whenever the user wants to load or save a disk file.

The main section of the Directory Assistant window displays a list of the files in the current directory. The files are grouped according to what application they relate to, so word processor files are shown in column one, database files in column two and so on. If there are more files on disk than will fit onto the screen, you can use page up and page down to scroll through. To select a file you simply highlight it using the cursor keys and hit Return.

One good point of the Directory Assistant is that it handles sub-directories very nicely. These are displayed in the right-most column along with any files that First Choice doesn't understand. To move to another directory, you simply select it and press Return.

Communications

The communications display looks exactly the same as the word processor screen. Most of the pull-down menus are also the same, although the communications section comes with a few additions to handle file transfer.

First Choice assumes that you are using a Hayes Smartmodem. If you are using another brand of auto-dial modem, First Choice comes with a set of 25 different modem drivers. Unfortunately the majority of these are presently designed for American modems, so you are usually forced either to use a Hayes-compatible modem or to dial manually. Imagineering, the distributor of First Choice, intends to produce a driver for Netcomm modems "in the near future".

The communications section allows you to set up details for up to eight different dial-up services. Using this feature you can set up the telephone number, baud rate, parity, and so on. After this is done, dialling a system is simply a question of selecting the service from the menu and waiting for the phone service to connect you.

The communications module also allows you to automate the log-on sequence for different services. Unfortunately all that this does is transmit a pre-defined string to the remote system once you get through. Although this works most of the time, it cannot handle bad lines or errors and so cannot be regarded as 100 per cent reliable.

In use, the communications section was quite impressive. The fact that most word processing functions are available within the communications section makes it very easy to play around with the look of text once it has arrived from a remote machine.

The main additions to the standard word processing functions are the ability to upload and download disk files. This can be done either in ASCII for text files, or by using the XModem protocols for transferring binary files between computers.

The only thing that the communications section can't do is handle Viatel graphics or split baud rates.

Documentation

As I mentioned earlier, the packaging and documentation were not complete in the review version of First Choice. However, pfs did supply a photocopy of the manual. This was made up of a tutorial section which is designed to be used along with sample files supplied on disk. This is followed by a reference section and handy hints on how to use the system.

Overall, I thought the manual was OK rather than outstanding.

Conclusion

I was very impressed indeed with First Choice. Up until now I have disliked every integrated package I have ever come across. I think this is because they generally try to do too much and end up being very complicated and costly.

I like the pfs idea of combining a more than adequate word processor with spreadsheet, database and comms functions which work well without being flashy. The great advantage of First Choice is that it recognises its limitations and doesn't try to do too much. The result is a system which is very cheap, easy to use and which should prove very useful for the 'average' IBM user.

First Choice costs $474 and is distributed by Imagineering; telephone (02) 662 4499.

END

BANKS' STATEMENT

System crash

Martin Banks is perturbed that we may be placing our very lives in jeopardy through over-reliance on the computer.

Now, this is something about which I don't know too much in terms of specific details. But I know this guy who goes flying quite a bit, who should know more than me.

Anyway, this guy says that he knows someone else; who flies the big jets — you know the type of thing I mean, all wings and engines and three hundred seats with no leg-room. These are beasts which really demand no flying skills at all, these days. As this guy said to me about the subject, it is now possible to fly one of these brutes from Sydney to somewhere interesting by simply pushing six buttons.

Two of those, not surprisingly, are START and STOP.

I reckon I could do that, so I suggested to this guy that maybe I should apply for the job of airline pilot. After all, said I, if I can drive a computer keyboard to write stuff like this, I have definably proved that I can push buttons. *QED.* I am ideally suited and fully trained for the task.

It was then that he pointed out a small, very minor, problem. Not only did I not have a pilot's licence, I have never even flown a plane. I tried to protest that this was not necessary as planes were now controlled by computers, I just had to say when to start and stop . . . even I could manage that, surely?

That was the easy part, I was told, but what would I do if the computer went wrong and the plane was in high-speed negative elevation mode? My suggestion of combining a rapid scan of the manuals with a lethal mixture of incantations to the goddesses and large gins didn't rate highly as a probable solution to such a problem.

At this point I started to think about the problem just a little. It seemed, or so I was informed, that the way modern big jet airlines are flown these days is by computer. The pilot sits there and pushes a few buttons to make sure it starts, makes some course corrections en route, lands and eventually stops. The pilot's prime responsibilities come down to some relatively easy functions, taxiing the beast around the airport and getting it lined up on the runway, ready for take-off.

After that, the job is simply to monitor the operation of the onboard computers and be there, with lots of expensive training predominantly going to waste, waiting and watching, just in case.

It was then that the thought struck me: *this*, as they say in all the best movies, *just ain't right*.

I have in my time flown a good many miles (at someone else's expense, usually) and the thought that I have been sitting somewhere seven miles above the waters of the Pacific while some somnolent pilot just might be forgetting to stay awake long enough to watch the computer have a funny turn, is just a trifle unnerving.

I am not sure that this is the way that computers should be used, mainly because it seems to be turning things upside down and back to front. It is a classic example of how we are making much of computers and their capabilities, and ending up putting all the reliance on them for our own responsibilities.

Up there in the aeroplane it is the computer that is doing the work, and the human being that is doing the monitoring — just making sure that things are going along OK and ready to take over should it prove necessary. Think about that for a second. It can be argued that this is completely the wrong way of doing things. What if the computer that is controlling the plane decides to go all peculiar just as the pilot nods off from terminal boredom?

In practice, it should be the other way round. Being complete morons, computers haven't got the intelligence (even of the artificial kind) to become bored, so surely, then, tenacity should be utilised to monitor the human being at the controls, rather than the other way round. I have no objection to the computer having the capability of flying the plane should it need to as a back-up to the pilot. I just worry about the idea of the main back-up system being someone who might have a totally numbed brain from nine hours of doing nothing but sitting.

This philosophy of putting so much reliance on comptuers to do everything for us is starting to appear everywhere, especially as the idea of expert systems catches on. Now, as I have said before in these columns, I quite fancy the idea of expert systems; they are a great way of capturing and utilising precious knowledge.

One of the ways in which such systems can learn, of course, is by actually observing an expert doing a job. In the aeroplane, for example, the system could be programmed to learn what the pilot does and how. Certainly they are already being programmed to fly a plane, but can they be programmed to deal with all emergencies? The answer is probably no, which explains why the human has to monitor the computer.

In the office, the humble PC is already proven as a great boon in any number of ways, but do we actually want it to do our jobs for us? I suppose that when it comes to working out an enormous spreadsheet the answer is probably yes, but that is relatively trivial in the great scheme of what things might be like in the future. A spreadsheet works on much the same principle as using computers to help fly a plane in a 'fly-by-wire' system.

Would we want the computer to not only enter the data into our spreadsheet, but choose which numbers should get the privilege? This is like having a word processor that actually does the writing. (OK, OK, there's no need to comment about that being a good idea. But just think, if the damned thing can write, it can also read, which might mean that eventually it might not require us at all).

All this is to pose the basic question: are we actually using all this wonderful technology we have created in the right way? It would seem that, having discovered that we can produce something that can do a particular job, we then abdicate from that responsibility ourselves. Taken to its logical absurdity, we may well eventually invent ourselves out of life, which doesn't seem to be the best use we can make of the best tool we've made.

END

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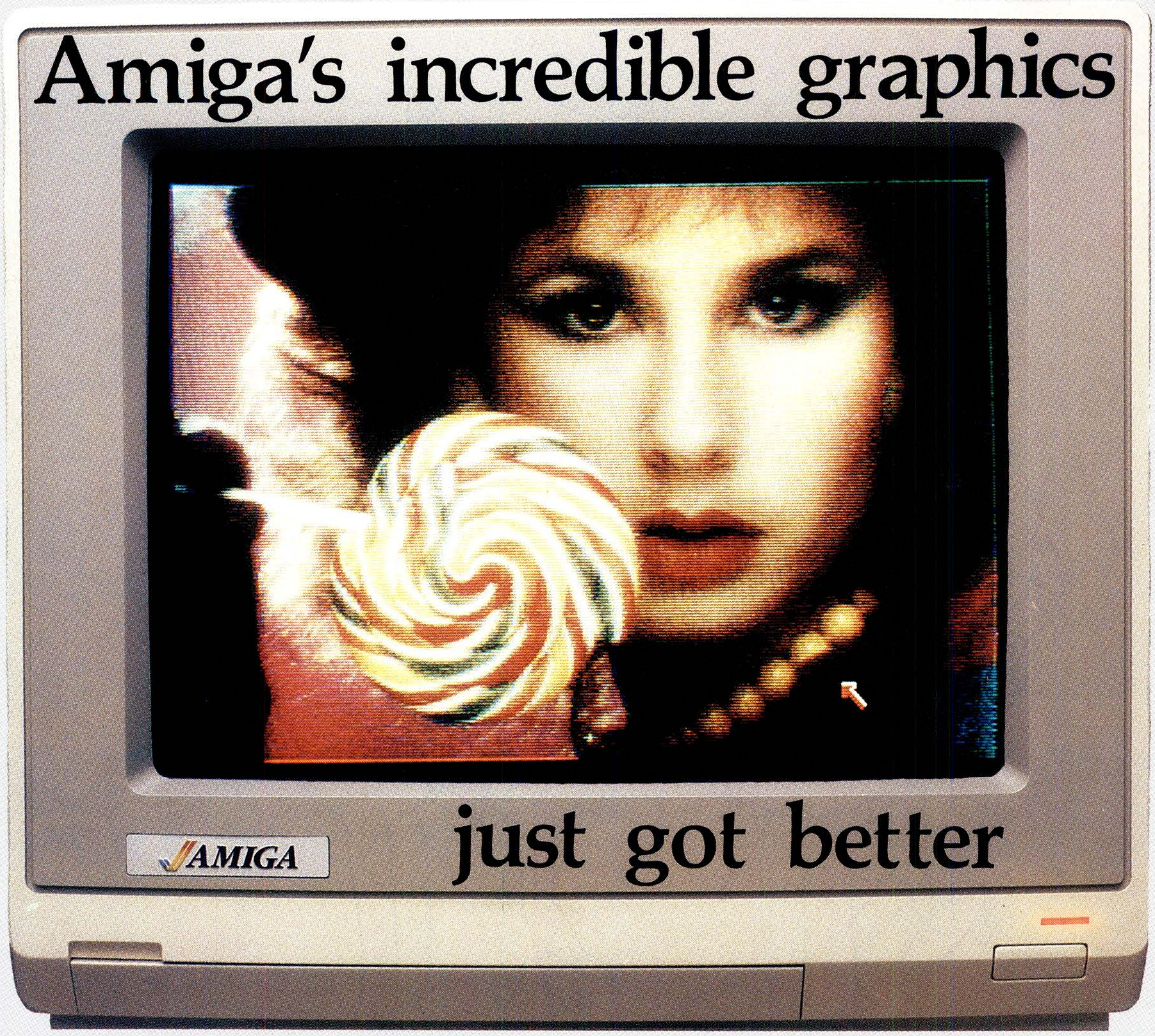

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Max no fields	10,254
Max digits	20
Special disk format?	
Link to ASCII files	Yes
Fixed rec structure	Yes
Amend rec structure	Only by copying data file
Link data files	Yes
No sort fields	16+
Max key length (chars, fields)	255, unlimited
Data validation	Adequate
Unique keys	Optional (package checks if requested)
Store calculated data	On input (or updating in batch), Batch process to change specified fields/records
Store selec criteria	Mandatory
>/criterion/field	Yes
Browsing methods	Any key for viewing or editing
Reference manual+	**
Reference card+	Not provided
Hot line?	
Max records size (chars)	10,000
Max field size	255
Max prime key length	255
File size fixed?	No
Data types	Numeric (inc. decimal point), character, date, array
Fixed record length stored	Yes
Nc data files open+	***16/32***
No keys	16
Subsidiary indexes kept up-to-date?	Automatically
Screen formatting	Default format supplied, paint-a-screen
Report formatting	Default format supplied, must specify columns and rows by number
Totals and statistics	Yes
Combining criteria	AND
Wild-code selection?	Field must start with specified character(s)
Interaction methods	Menus, full tailoring
Tutorial guide+	***
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Figures in italics for TAS Plus/Developer's Version

Fig 1 Features and contraints

number of fields, are relaxed in that version, in many cases through the provision of a fixed area of memory available to the user program but not overwritten by TAS itself. This area of 96k allows you to have much larger records than would be permitted by most packages, but you do have to control its handling yourself, to a much greater extent than if you stick to the basic provisions.

File creation & indexing

TAS Plus provides three methods of creating a file. The simplest way is to use the 'Create database' option on the main menu; this asks you to enter the name, type and length of each field, and makes entries in the overall data dictionary that defines all the fields in one database. When the definition is complete, TAS Plus creates a basic data file with no records, and allows you to enter records using a default screen layout of one record per line. Subsequently, you may define a data entry screen using 'paint-a-screen' methods. The second approach is to paint the data entry screen first, and to define each field as you go; these definitions are then added to the data dictionary by TAS Plus. Or, using the third method, you can amend the data

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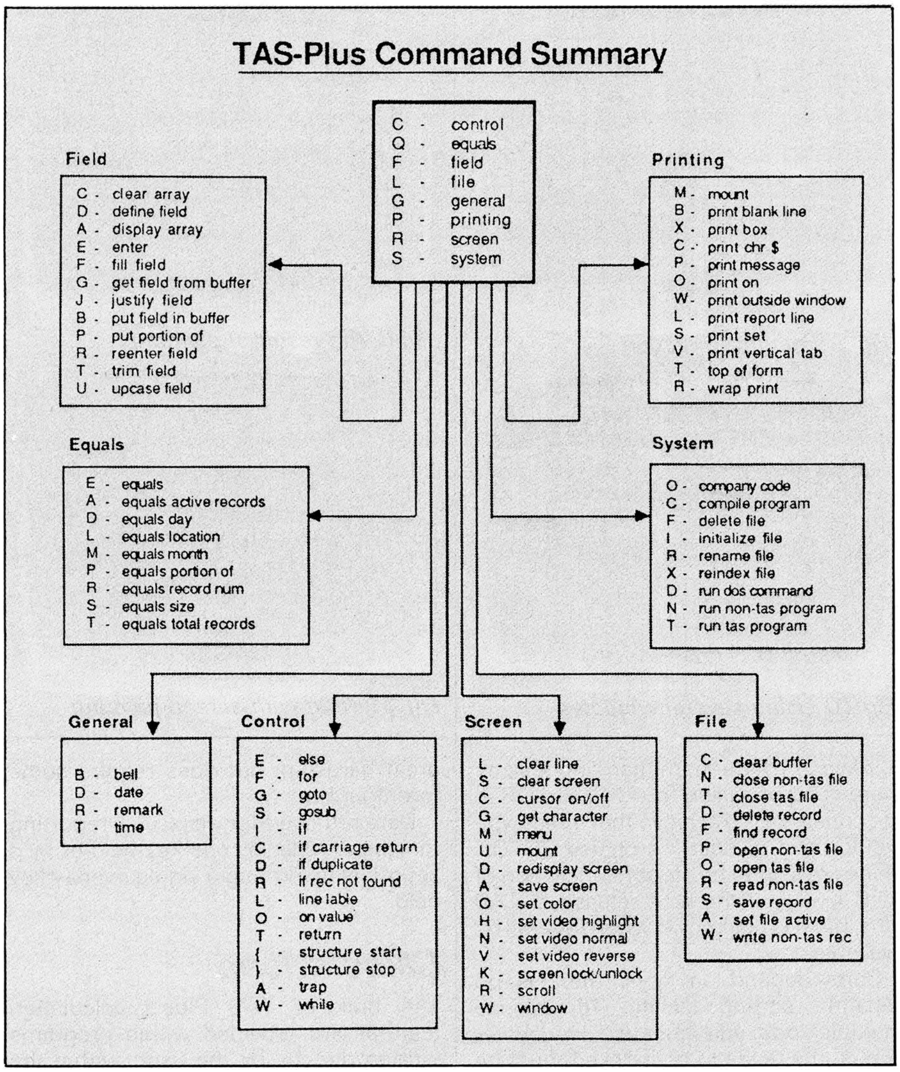

Fig 3 Programming language 'road map'

dictionary directly, and follow it with screen entry design. For a complex application, with several related files, the last method would be the most convenient; the advantage of the data dictionary approach is that you simply need to define a field once, and whenever it is referred to in another file, the definition is recalled.

In any one file, up to 16 keys may be used to index the file. Indexes can be used to recall records quickly, and to determine the order in which the records are retrieved. Keys may be single field, or combinations of several contiguous fields defined as overlay fields. (The restriction to 255 characters applies to the total key length).

Data input & updating

Data can be entered onto the default screen layout provided by TAS Plus, or onto a tailored screen defined by the user. The simplest method of setting up a screen layout is to use TAS Plus's program generation capability to set up the necessary program. This allows you to control the layout, and the order in which data is entered. If you want tighter control — perhaps to validate data in detail, for instance by checking that an entered value already exists in another file — you can then amend the program built by TAS Plus, using the internal editor. Screen layout programs can, of course, be built from scratch, but the mixed approach is likely to be faster and less error-prone for most applications.

Records are retrieved for screen display either by scrolling through files in record number order (initially data entry order, though this will be disturbed when records are deleted), or by finding records by key. Key matches may be exact or 'nearest' to the value entered in the appropriate key field. If you begin your search by requesting the first record in that key order, subsequent retrieval of Next or Previous record will fetch

B - binary character
C - close variable file
D - display memory
N - file name search
M - fill memory
F - find rec var file
P - memory ptr update
S - memory space update
V - move string
O - open variable file
K - pop stack
E - print screen
R - redefine field
T - trace enable

Fig 4 Additional commands

records in order by that key.

TAS Plus also provides a 'browse' facility, in which 10 records at a time can be displayed on the screen and amended if desired. You can display all the fields in each record, in which case you cannot select subsets of records, or a subset of fields, when you can also select a subset of records.

Records can also be created and amended under program control. This allows you full control over record handling, either when amending records onscreen, or when changing batches or records without user intervention.

Screen display

Without writing your own program, you can display data on the screen in four ways: the default one-record-per-screen format provided by TAS Plus; a 'browse' format in which 10 records are displayed on each screen; a tailored layout painted by the user; and a report format. All but the last allow data amendment; report formats are for display only. With TAS Plus's programming facility, you have full control over screen display, including direct cursor addressing.

Reports

Reports in TAS Plus can be sent to a printer, to the screen or to a file. They can contain a maximum of 60 line formats of 128 characters each; by having two formats on one line, you can print up to 255 characters per line if your printer carriage is wide enough. Control characters may be sent directly to the printer, and page formats can be controlled (for example, the number of lines printed per page).

Formatting within the report can be allowed to default to that set up by TAS Plus, using a simple columnar layout, or determined by program, specifying

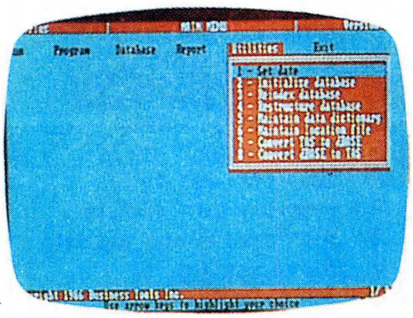

Fig 2 TAS Plus main menu

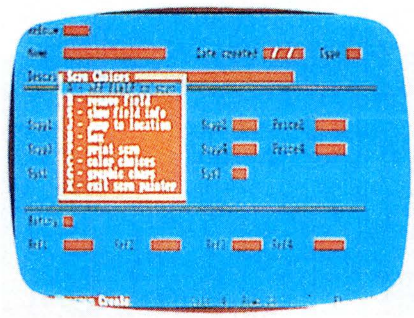

Fig 7 'Painting' a screen

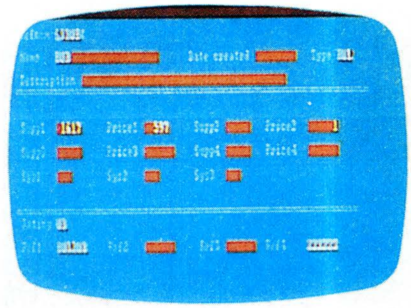

Fig 8 The result of painting

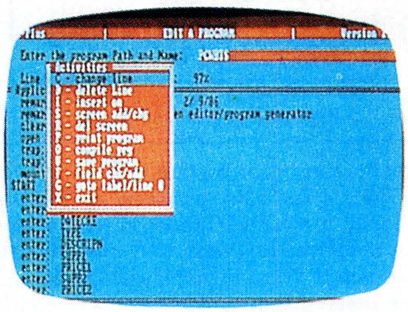

Fig 9 Using the editor

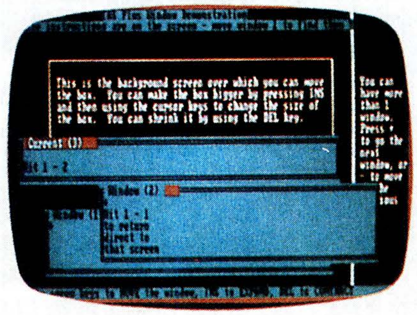

Fig 10 Using several windows

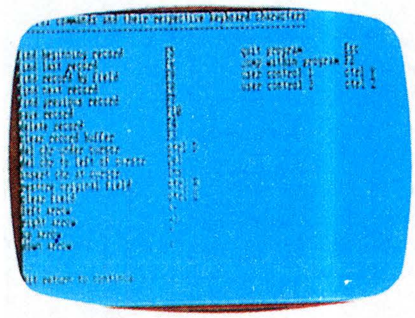

Fig 11 Help with screen painting

columns and rows for report elements. In the default mode, where the program is set up by TAS Plus, you can specify the field or fields used to select records when the report is run, for example to report on the names of all customers who are within 10 per cent of their credit limit. Reporting, like all TAS Plus retrieval operations, is always a two-stage exercise — first the format and selection parameters are defined and saved, then the report can be run as often as you like.

Selection & sorting

The selection options in TAS Plus are probably its weakest aspect. When using the basic TAS Plus provisions for retrieving records for amendment, you can find records with an exact or inexact match on any key field. For reports, you can select records falling within a range of values for any or all fields (not just key fields); this allows you to report on the records of all customers owing between $1000 and $2000, but not on all those living in South Melbourne or Port Melbourne. If you test more than one field, the results are always added together, so that records must pass all tests to be included.

In the programming language you can achieve a little more flexibility, as there is an IF condition THEN ... ELSE construct, where the condition may employ a relational operator, or may use a test for the existence of one string within another. The IF condition cannot, however, include more than one test, as there is no provision for AND and OR in the condition. To achieve that effect, you would have to nest IFs or use GOTOs. Plans are said to be afoot for inclusion of AND or OR in the next release of TAS Plus, but it is not known when this will be available.

Sorts depend on keys; there is no separate sorting facility. To achieve multiple sorts, you must use overlays — that is, the fields to be indexed must be adjacent in the data file. (Since data may be entered on the screen in a different order from its storage in the file, this is no great hardship, but does require some forethought).

Data retrieved for display or reporting may be in order by one key field or by a set of fields forming a single overlay key field.

Calculations

The bulk of TAS Plus's calculation features are provided within programs written directly by the user; within the automatic program generation facilities, the only provision is for totalling in reports.

BM1	Time to add one new record	3secs
BM2	Time to select record by primary key	Inst
BM3	Time to select record by secondary key	Inst
BM4	Time to access 20 records from 1000 sequentially on three character field (same field as in BM2 key)	43secs+
BM5	Time to access record using wild-code	53secs
BM6	Time to index 1000 records on three-character field	8mins20secs
BM7	Time to sort 1000 records on five-character field	13mins25secs
BM8	Time to calculate on one field per record and store result in record	15mins3secs
BM9	Time to total three fields over 1000 records	2mins35secs
BM10	Time to add one new field to each of 1000 records	3mins

Time to import a file of 1000 records: 13mins59secs
NT=Not tested; NP=Not possible; +=including scrolling. Where two times are given, first is access to first record, second is access to each subsequent record

Fig 5 Benchmark times recorded on IBM PC-XT/H

Package	Cost ($)	Summary
Dataflex	1920/2520	Powerful, flexible database management system available on a wide range of single-user and networked systems. Excellent for system developers, good for novices prepared to apply themselves. Clumsy manual, excellent reference summary and examples
Omnis 3 Plus	949	Probably the most powerful data management system for the Mac. Allows development of sophisticated systems using simple methods, well-integrated with Mac approach. Permits 12 data files open, fixed-length records. Powerful screen layout and reporting
Paradox	1470	Table-based system for IBM PC, many similarities to 1-2-3. Tables can be related. Good querying and reporting, powerful command language. Keeps data in memory if possible: speed on larger tables should be checked. Easy to use at basic, menu-driven level
Reflex	214	Hybrid data management/spreadsheet/ business graphics. All data must reside in memory, but can filter larger database from disk — updates done correctly when file is saved. Very cheap, good importing, so could provide reporting for other spreadsheets
TAS Plus	199/569/869	Combination of good, basic menu-driven facilities with powerful programming tools make it excellent value for money, especially for novices wanting to learn, and developers wanting economical run-time system

Fig 6 Comparison of similar data management packages

Within the programming language, you can carry out the conventional range of arithmetic calculations, using expressions which are ordered from left to right without any precedence ordering, except that material within brackets is evaluated first. Time and date calculations work correctly, and arrays can be used in arithmetic expressions.

Multiple files

TAS Plus is unusually flexible in its provision for multiple files. In the basic package, up to 16 data files (not including indexes) may be open at one time; in the Developer's Version, up to 32 files are allowed. In case anyone thinks this is magic (since the effective DOS limit is 16), what actually happens is that no more than 16 files are ever open at once, but TAS Plus takes care of the opening and closing needed, keeping note of pointers and restoring them when files are re-opened. Apart perhaps from some small time penalty, the appearance is of 32 data files. In practice, most people won't reach the 16 limit, since it is usually the need to include index files in the count that restricts users of other packages.

Linkage between files is accomplished through keys; when you need to retrieve a related record, you specify the key to be used in the target file. Screens may contain fields from more than one file, and several files may be updated from a single screen.

Tailoring

While you can use TAS Plus in a basic way without becoming concerned with tailoring, the package really comes into its own when you use the extensive range of tailoring facilities provided through its command/programming language. These features are extended further in the Developer's Version. The author of TAS Plus previously designed the Sensible Solution database system, and the programming features of the current product bear some of the hallmarks of that system. It has been improved in a number of ways, such as the provision of a more extensive range of control facilities. The 'road map' for the TAS Plus programming language is shown in Fig 3, and the additional menu of commands in the Developer's Version in Fig 4. The latter also provides a variety of extra goodies, including the ability to refer to files by number rather than by (constant) name.

Simple programs may be generated automatically, using TAS Plus's Create Program and Create Report facilities. There is also a feature that allows you to create tailored menus. More complex programs can be built up from those generated automatically, or written from scratch using a screen editor, and employing drop-down menus to construct programs on a step-by-step basis, which should make life easier for beginners.

The editor provides a good example of what can be achieved in the TAS language — itself a program of over 5000 statements, it allows you to create and edit a program whose source code occupies up to 96k of storage. Larger programs (or the programs of those who believe it to be beneath their dignity to use anything so naive as a menu) can be created with a conventional text editor, and processed with the TAS Developer's Release.

This approach has been used with the suite of programs written in TAS (suitably 'Australianized') to carry out basic accounting functions: debtors, creditors and general ledger are available for $999; and together with stock control and purchase and sales order modules sell for $1429. Both packages include a single user developer's version. Since the source of the TAS programs are included, users essentially acquire an accounting suite that they can tailor to their own requirements, including processing their precious data in a variety of other ways — even now a rare feature on conventional accounting packages.

The programming language has only rudimentary procedure facilities — GOSUB, with no parameter passing — and the conditional facilities are, as I showed earlier, primitive. But the language does include some features not universally available, such as full control over screen colour, access to the full range of IBM characters including the graphics symbols, a windowing feature allowing you to open windows onto several screens at once (very fast), the ability to amend function keys, and trace and debugging facilities. You can also run DOS commands and the DOS programs with parameters in both cases, so that it would be feasible to set up complete systems in TAS Plus.

Links with outside

TAS Plus provides a built-in facility to exchange files with dBase (either format), and also the building blocks with which you can write programs to import and export data in a variety of ASCII text formats. Indeed, the ability to read ASCII files within TAS Plus means that in some circumstances you could

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TAXAN KX1212	$335.00	X	✓	X	20 Mhz	18.432 Khz	−10°C to +40°C	6.8 kg	X	X	205 mm x 150 mm
ROLAND MA-122	$262.50	X	✓	✓	20 Mhz	18.432 Khz	0°C to +40°C	7.0 kg	X	X	195 mm x 146 mm
QUBIE HR39	$320.00	✓	✓	X	20 Mhz	18.432 Khz	−10°C to +50°C	9.8 kg	X	X	204 mm x 135 mm

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'milk' the ASCII records of the information needed without actually converting them to TAS Plus format, which could save time and disk space in some applications (for example, local processing of mainframe data).

User image

At the basic level, TAS Plus is a menu-driven system, using drop-down menus to provide users with choices, and help at the touch of a function key. A user with modest requirements could, with very little effort or previous experience, set up simple systems quickly.

To do more, you must come to terms with the TAS Plus programming language; the suppliers call it that, and I have stuck to their term, since it more nearly resembles a language such as Basic than a command language of the type common to most of the big fish in this market.

This learning process is made much easier by the use of menus to lead you through the maze, and the ability to inspect and modify the programs written by the TAS Plus program generator is a big help. I would expect it to take a bit of effort for people who have never programmed before, but whether the amount of effort would be less or more than learning a command language, I find very hard to judge.

Documentation

I suspect that some of my readers regard me as a perfectionist over documentation, and it's true that I do care very much that a manual should be clear, concise, comprehensive and easy to follow. The TAS Plus manuals are adequate, but no more. The first half of the main manual consists of an extensive tutorial, which is above average in most respects: it fails (in common with virtually all American products) to provide a proper overall picture of the TAS approach, the skeleton on which to hang the details of how it works in practice. The second half is the reference section, of which the best thing is the 'road map' reproduced as Fig 3. The text seems to be aimed at programmers, yet has no formal syntax definitions; it essentially falls between two stools, being too terse for novices, too imprecise for experts.

The manual for the Developer's Version follows similar lines; for example, the explanation of multi-user features is split between two sections, and some things seem to have slipped through the gap. (Perhaps it is worth putting in a plea for more redundancy — appropriate repetition — in documentation; systems people rarely see the need for it, but then they have not spent hours wishing they had four thumbs to keep all the relevant sections open at once, and a crystal ball to guess at the gaps between the various parts of the overall explanation).

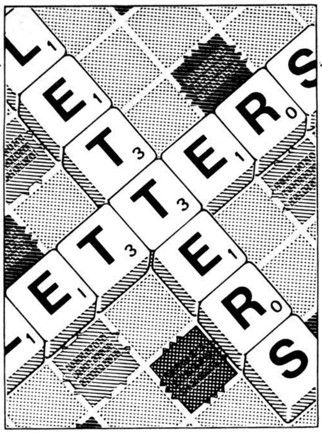
On the plus side, the manuals are typeset, and light and small enough to be genuinely portable (I'm seriously thinking of buying a luggage trolley to take the weight off my arms when lugging about the three hard-bound volumes most suppliers find it necessary to provide, presumably on the principle of 'never mind the quality, feel the width'). The tutorial section is OK, and there is a good index.

Conclusion

For its price, TAS Plus (and its extended versions) have to be excellent value for money. The paucity of selection facilities, and the awkwardness of parts of the programming language, will deter some, while the absence of an extensive library of numerical functions will rule out applications heavy in calculation. The ability to compile tailored programs, especially for system developers who wish to protect their investment, is a large bonus. END

Summary

Supplier:	CPS Systems
Telephone:	(08) 223 6222
Cost:	$199/$569/$869
Version reviewed:	2.04
Type:	S,E
Features:	Basic features offer simple data entry and reporting from flat files using menus. Powerful programming language provides a wide range of commands to process up to 16 open data files linked by keys. Windows, Compiler, Networked version, Developer's version.
Drawbacks:	Selection criteria limited; no AND or OR in programs. No parameter parsing or external subroutines.
Ease of use:	Basic system good for novices, gives gradual lead-in to programming. Some commands in programming language rather cumbersome



LETTERS

This is the chance to air your views — mail to 'Letters', Australian Personal Computer, 2nd floor, 215 Clarence Street, Sydney 2000. Please be as brief as possible and add 'not for publication' if your letter is to be kept private.

T-time

With reference to the (entirely justified) rantings of Mr Kewney in respect of 'A Mess DOS' (*APC*, August) and the inferences drawn with regard to the Strategic Defence Initiative, if one makes allowance for the typographical omission which seems to plague every reference to it by its popular name, the Start Wars programme can be seen as eminently suited to its purpose.

M Radmore

A good point, not to mention a long sentence.

Intelligent reply

I wanted to bang off a short, sharp reply when I read David Levy's introduction to artificial intelligence (*APC*, August), but because he goes into such detail, *I felt I had to.* Sorry about this, but as one who'd like to see intelligent machines about the planet — and who paid good money to read 'Wise moves' — I take exception to just about every single word written.

Without looking it up I suggest that his dictionary equates intelligence with perception, but there are dangerous differences between levels of perception. It seems to me that David Levy has blundered straight into one, because the entire thrust of all the detailed examples in his argument deal with accomplishment, which is largely irrelevant,and ignore real understanding.

To say that a thing, or person, demonstrates any real intellectual prowess because it or he or she responds correctly to a given situation, on or off the chess board, is nonsense. All that has been demonstrated is the ability to respond correctly, as when a push on a button causes a doorbell to ring.

Intelligence will be demonstrated by the ability not to recognise, but to explain the situation, the response, and the relationship between them.

It might be reasonable to assume that chess masters are highly intelligent, but may we not also assume that either of the two programs mentioned would *at the same level of play* show a higher consistent success rate that its creator, because it is not prone to his human errors? But you will not then conclude that it is more intelligent.

It is in developing his argument from the spurious premise of the intelligent chess programs that Levy wanders way off the track. Quote: '. . . a human who plays chess well, composes music, writes poems, or can prove theorems in logic, *must* be intelligent,' we are told, but it is really only the proving of theorems which counts.

Chess, as we have seen, music, sadly, and, even, as we are later shown in 'Woman, why do you create your face . . .', something akin to poetry can be programmed, but verbiage is not poetry and there is all the difference in the world between being able to solve problems and being able to prove theorems.

The Turing test is a nonsense since it will happily 'prove' that the machine is as intelligent as its creator, which we know is not the case. That a given subject thinks the machine understands her well, proves nothing.

Many aspects of intelligence should be distinguished, but the ability to achieve an impressive result takes us back onto spurious ground — unless perhaps you will have that he is more intelligent who can kick a footy further.

Leaving aside the effect of the infinite monkeys typing Shakespeare on the degree to which creativity measures intelligence, let us follow Levy's 1978 championships.

However beautiful the result, the test for intelligence is not whether one machine can beat another, but whether either of them can explain how the result was achieved — or even the basic rules of the game. I suggest that neither can.

Since I'm not allowing the Turing test, the Pfleger deception also fails and we move on to popularity — a great test of truth as every FlatEarther could have told us centuries before there were such machines.

There are many measures of creative art but if the selected poetry readers had been of significant numbers, or qualified to judge, we would still be left with the simple fact that the program did nothing more than follow strict rules laid down by its creator.

Up to this point the issue has been obscured by the question of *impressive* results, when *meaningful* results should have been our object.

As it happens I do think there is a lot of point to research into the 'machine mind', but we will have achieved artificial intelligence only when the artefact can respond in a fashion not predictable within the initial constraints of its programming, as well as its knowledge, through either experience or inspired thought.

If, however, the search is really for that which Levy describes, then the seekers must have been reading a very strange dictionary.

R Goodwin

Guy, Guy, Guy . . .

I was most amused by Guy Kewney's comments on 'A Mess DOS' ('Newsprint', *APC*, August) but find it difficult to sympathise with his problems, or his conclusions.

I, too, have been using MS-DOS for several years. I have even been known to train clients in its use; in my experience, a modicum of common sense can make a colossal difference to the results obtained — an observation which is equally true of every other aspect of computing.

Taking each of Guy's points in turn, it seems unduly harsh to claim that MS-DOS 'sabotages' the

GEM mouse. MS-DOS was around long before GEM, and the failure of GEM to integrate properly is surely due to Digital Research rather than to Microsoft. Using the same reasoning, the dangers of 'FORMAT' when using the Xitan shell suggest that it is Xitan which is at fault. Any user planning on formatting a disk will either have used this command before, and know the correct syntax, or will not have used it before, and should look it up in the manual. Anyone who issues a command to a computer with no idea of how it operates deserves all he gets.

I was surprised to hear of a Microsoft program called 'ST' or 'PQ'. I take it that this was nothing to do with MS-DOS, since I can find no two-digit commands in my DOS manual and only one two-digit sub-command ('IF') which is *blatantly self-explanatory.*

Guy's prose really begins to soar when he reaches the subject of 'RMDIR', an innocuous enough command. My MS-DOS manual is for the IBM PC version 2.1, and being a simple sort I normally start with the 'Contents' page, rather than the 'Index'. The list of DOS commands fills exactly one page, and gives 40 commands. Each abbreviation is followed by a plain English translation in the format: RMDIR (Remove Directory) Command . . . 2-132. With just 40 commands to check, I don't see that you need to know this in advance.

Even if I did not want to look for 'Delete Directory' or 'Directory, Delete' in the Index, my Index gives me (on the same page and in the same column) 'deleting a directory 5-10' and 'directory, remove 2-132'. Look up either command, and it will tell you that the directory must be empty if the instruction is to work. The syntax for both commands is clear, and is a million miles away from a medical insurance claim form. Guy's complaints yet again say nothing about MS-DOS, but speak volumes about Olivetti documentation.

Moving on to the creation of a file called 'FRED' when there is already a directory called 'FRED', surely all this proves is that Microsoft feels no need to state the obvious. To consider this a fault of MS-DOS is quite ridiculous; I have direct experience of nearly a dozen types of DOS and none of them will allow you to do this unless the file is created inside a sub-directory.

I should stress that I have no connection with Microsoft, nor have I any particular reason to take up the defence of the product. But I do feel that, if you are going to criticise MS-DOS, you should make an effort to do so on better grounds than Guy Kewney's. When I am training a client in the use of MS-DOS, I normally start by saying: 'This is going to be easier than it looks,' and the client usually agrees with me by the end of their lesson. An over-critical and badly-reasoned article such as Mr Kewney's doesn't help me in my job, nor does it help the thousands of users across the country who have little choice but to use MS-DOS.

If only to show that I have nothing against Guy personally, I will finish this letter by stating my complete agreement with his comment on the Star Wars software — I wonder what the response time is for 'software support' after a program crash in geo-stationary orbit?

Jack Nicole

PCW8256 angled text

My article on GSX Graphics with the Amstrad PCW8256 ('Graphic Design', *APC*, July) omitted to describe how to select the different directions in which text may be printed. The required SET function is listed in Table 1 of the article and needs CONTROL%(0) set to 13 and CONTROL%(1) to 0. It also requires three values to be passed to GSX in the array PAR.IN% and they are rather complicated. If the four allowed text directions are denoted by a variable 'u' which can take the values 1,2,3 or 4, then the following assignments are needed:

PAR.IN%(0) = (u −1)*900
PAR.IN%(1) = 100*(u MOD 2)*(2−u)
PAR.IN%(2)=100* (1−u MOD 2)* (3−u)

I shall not attempt to justify these expressions, but if they are entered as shown and followed by a CALL to GSX as described in the article, they will allow any of the four directions to be chosen.

R Gilmore

Cryptic comments

A Simpson is absolutely right in his suggestion for eliminating the bottleneck in my Enigma program ('Enigma variations', *APC*, June). My first thought on seeing his letter (September, *APC*) was to say: Why didn't I think of that? The only excuse I can come up with is that I was too close to the problem (yes, I know that sounds like a lame excuse but it was the best I could think of). Seriously though, I would suggest that anyone experimenting with the program should incorporate Mr Simpson's ideas.

He may be interested to know that I have been spending my time writing an assembly language cipher program (ULTRA) which is based closely on the Enigma method but with some of the bad points of Enigma removed. In particular, the self-inverse feature of Enigma, a major weakness, has been removed by the use of separate input and output plugboards. I have also included a few nice touches such as word-wrapping of plain text and formatting cipher text into four character blocks. Although ULTRA is not yet finished, the speed improvement, even without the inclusion of Andrew's technique, is surprisingly large — the program will encipher 1024 characters in two seconds!

For any readers who are working on cracking the challenge text included with my article or who have already done so, then they will be able to decipher the following piece of cipher text which was enciphered using the same machine setting: IHEFMCEVMPNNUPVPLL LGZKU*LCLHYKBBM. It is the title of a Latin text produced by the early Christian Church.

Of course, writing a decryption program is more difficult than writing a cipher program, but if anyone *can* come up with a decent program, then I'm sure many readers would be interested in the method used.

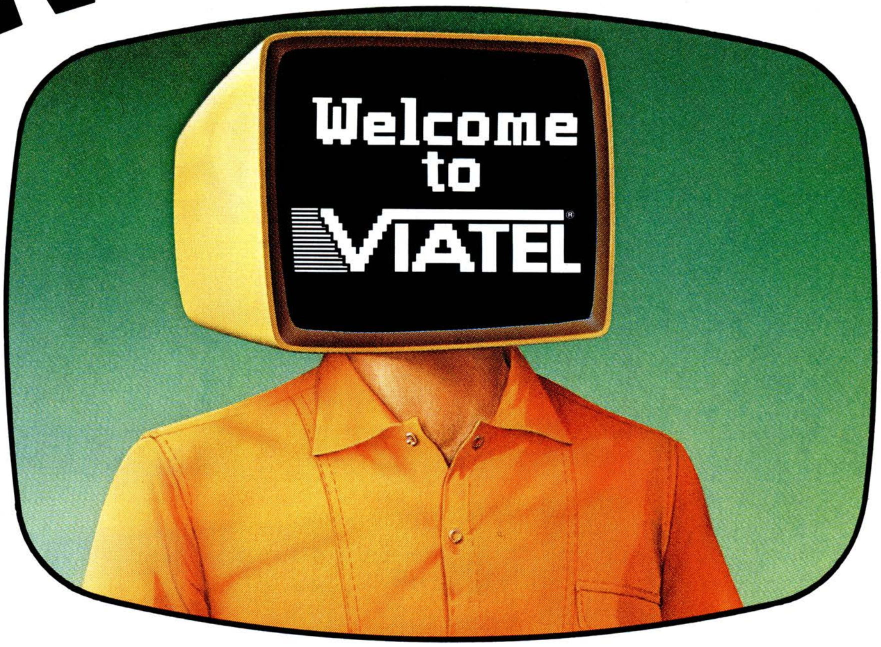
Colin Davies

Out for the count

I trust you will agree that in mathematics, above all other disciplines, accuracy is of the greatest importance: Mike James's article (*APC*, September) contained a whopping great howler, where he explains the 'real' numbers. They are indeed 'uncountable' in strictly defined mathematical sense, but his statement that their '. . . most important property is that given two real numbers, there is always a third that lies between them' does not imply uncountability. The quoted property is shared by the so-called rational numbers (='common fractions') which *are countable*, as any competent mathematician would confirm.

One says that the set of all

BETTER FOR MICROS



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rational numbers is *dense,* cf *Mathematical Analysis,* by T M Apostol (Addison-Wesley Publ Co Inc 1974) on p68. For a demonstration of countability (or 'denumerability') see *What is Mathematics?* by R Courant & H Robbins, OUP, 1941, p79). The next three pages give Cantor's famous proof that the *real* numbers are not denumerable — that is, they are uncountable and also dense.
Ed Rosenstiel

A Clayton's Prolog?

While not claiming to be an expert in the use of the Prolog language, I was under the impression that one of the fundamental properties of Prolog is its ability to manipulate both facts and rules as part of the database.

This property is essential to the use of Prolog as a language for programming artificial intelligence applications which require the ability to 'learn' by deducing rules from facts and adding these new rules to the database.

In your 'Screentest' of Turbo Prolog you state that "One of the only restrictions found in Turbo is that only facts can be altered dynamically, not rules".

Surely the lack of such a fundamental property in the Turbo language makes it misleading to call it Prolog?

I realise that this raises the whole hoary question of language standards, but surely one must draw the line somewhere when the basic uses of a language are compromised.
R Thorpe

While also not claiming to be an expert in Prolog, I must say that I believe Mr Thorpe makes a valid point. The ability to dynamically alter the knowledge and rule base is certainly a crucial feature in many applications of Prolog.

While Turbo Prolog does implement most of the features described by Clocksin and Mellish (Springer, 1981), the two most noticeable omissions are the one mentioned above, plus the inability to define your own infix operators. However, in fairness to Borland, one must also point out some of the good features it offers above and beyond the early Prolog standards. These include 'normal' arithmetic expression notation, retention of variable names and, of course, the fact that Turbo emits compiled code.

Perhaps these additional facilities do not compensate for the lack of a feature which Mr Thorpe feels comprises the language to such an extent that it is no longer 'Prolog'.

However, one must recognise Turbo Prolog for what it really is. Turbo, I believe, is one of the most accessible and usable versions of Prolog available today. Turbo will end up being a vehicle through which today's programmers obtain an appreciation of logic languages. Although dynamic rules may be very important for particular real world applications, the lack thereof should not adversely affect Turbo Prolog's success in exposing newcomers to Prolog. The rules embedded in the program can, of course, be changed, so additional rules have to be added through program alteration and recompilation. It is only the Asserta and Assertz predicates that are limited to facts.

In some ways, Turbo Prolog will have served a useful purpose even if nobody builds a major application with it. On the other hand, however, I believe that it is *possible to create a useful application without these features. The natural language query system provided with Turbo, although not terrific, is testimony to this.*

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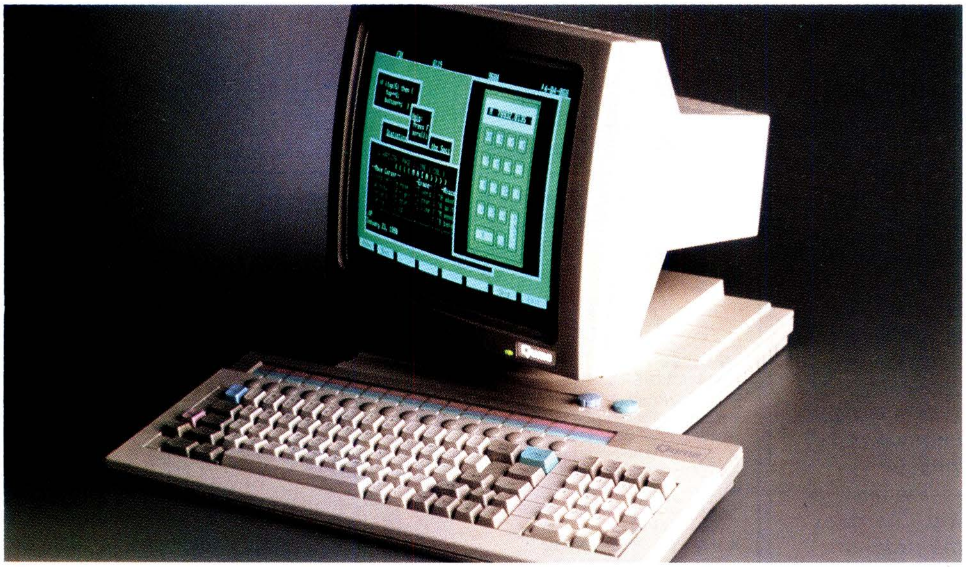

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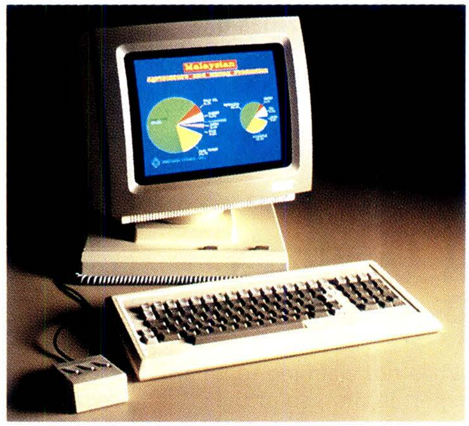

In fact the QVT202 features better ergonomics than the VT220. The durable HI-RESPONSE capacitive keyboard has superb feel, the 35cm non-glare tilt swivel screen is easy on the eyes and an exceptionally compact and stylish case adds to the productivity of this terminal.

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Comparing it to Micro Prolog and Prolog-86 clearly shows the superiority of Turbo Prolog for the newcomer. These other implementations have no trouble providing dynamic rules since they are totally interpretive. Turbo, of course, is completely compiled into native code and as such, applications can be distributed without runtime licences.

Perhaps people with experience in Prolog, as Mr Thorpe seems to have, should look elsewhere for their preferred Prolog. However, it would be interesting to see how many Prolog connoisseurs are tempted back to Turbo by its usability, features, speed and price.

Ian Davies

Synaptic follow-up

With reference to the article in April 1986 issue of *APC* titled 'Simulating Synapses', I would appreciate details of where this information can be found in literature (eg. a bibliography). You note that research is being done in the area and I am interested in following up the topic. Any help you are able to provide will be gratefully received.

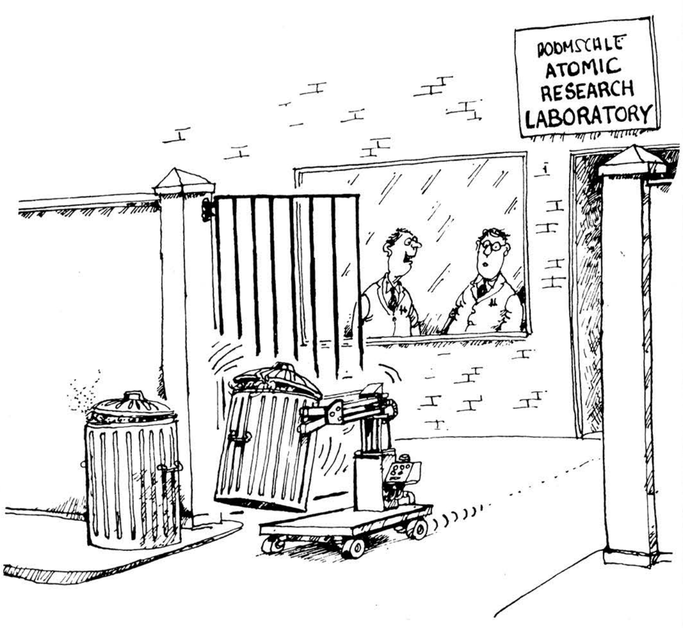
R McArthur

More information can be found in "Introduction to Artificial Intelligence" by Phillip Jackson (Petrocelli, 1974); the various works of Roger Schank of Stanford University; "The Shape of Intelligence" by H. Chandler Elliot (George, Allen & Unwin).

Research is currently being undertaken by (among others), Geoffery E. Hinton of the Carnegie-Mellon University, Pittsburgh; Jerome A. Feldman of the University of Rochester; Dr. John K. Stevens of the University of Toronto. Additionally, a company called Nestor Inc. in Providence, Rhode Island, is said to have a commercially marketable product using self adaptive pattern recognition neural networks which they plan to apply to handwriting and voice recognition problems.

Ian Davies

END



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When a user loses money due to faulty software, who's to blame? David Ahl presents his evidence in this month's US report.

Whose fault?

Can software makers be held responsible for a user losing money because of a glitch in the software? Software makers say 'no', but a landmark case is going to trial that has software makers very nervous.

James A. Cummings Inc, a construction firm, prepared a bid for a Miami office-building complex using Lotus Symphony. The preparer omitted $254,000 in general expenses and, when he realised he had done so, inserted it as the top line in the column of cost figures. The figure appeared on the screen and the printed bid, but it was not added to the total because it was outside the range of the summation formula. The lawsuit states that this was unknown to Cummings at the time and seeks $254,000 in damages from Lotus Development Corp. Lotus contends, of course, that Cummings made the error and that it (Lotus) has no responsibility.

In general, software makers contend that they can't be held responsible for a user losing money because of a glitch in their product or instructions, "No software maker has represented that their software product is perfect — there are too many ways it can go wrong, and we tell people we can't take that responsibility," says Geoffrey Berkin of Ashton-Tate.

Today, most software packages come with 'as is' warranties which don't even provide for the correction of flaws in the software. Other warranties, including that of Lotus, say the company will only replace a defective disk.

These limited warranties are part of a licensing agreement used in software purchases under which the buyer doesn't own the program, but licenses the maker's property. Thus, software makers have said that a buyer can't sue for flaws in a product he doesn't own. Most packages state that buyers agree to the conditions of the limited warranty when they remove the plastic 'shrink wrap'.

Nevertheless, there is growing sentiment that software makers must accept *some* responsibility for products that are promoted as time and money-saving tools for businesses. 'If software doesn't perform in accordance with its specifications, a company should be liable because they're selling a sophisticated product and they intend people to rely on its performance,' says Robert Arkin, vice chairman of the Minnesota Software Technology Commission.

Kits revisited

In the mid-70s, personal computers came in kits. The basic box contained nothing but a power supply, a front panel with lights and switches, and an empty bus (with as many as 24 slots). Yes, no motherboard — everything plugged into the common bus; CPU, memory, video interface, floppy disk controller, printer interface, and so on. Upgrading was simple. When a Z80 CPU came along, you simply pulled out your 8080 CPU card and plugged-in the new one; likewise with memory or disk controllers.

But then came the Apple, Pet, TRS-80, Kaypro, IBM PC and clones, *et al,* with a motherboard containing the CPU, some memory, and possibly controllers and interfaces. When a machine of this type is superseded by a new model, you must scrap the old computer and spring for a new one. Sure, prices are coming down, but therer is still a fair chunk of hardware that is duplicated.

But now, along comes Computerland with its Korean-built BC 88 with *no* motherboard. Brilliant! By using the bus concept with a beefy 150-watt power supply, the BC 88 eliminates as much of the built-in obsolescence as possible. The same box can start as a PC, and a year later migrate up to an XT or an AT. It can go from black and white to colour, and, of course, easily absorb more memory. It can be an 8086 machine or an 80286 machine. Whatever you need or want it to be, it can be. And since the most common perception of the electronics industry is that 'next year it will be cheaper because it will be obsolete', this machine is a philosophical and marketing breakthrough.

The implications for third-party manufacturers (and customers) are tremendous: upgrade this, add more power to that, speed up your computing — everything is modular. My only questions are: why did it take so long; and when will other manufacturers start producing modular machines?

High tide, low prices

Computer software publishers are joining the makers of cut-rate PC clones in a scramble toward lower prices. The growing number of cheap computers from Taiwan, Korea and Hong Kong is forcing customers to look at software in a new way. If a company spends $US600 on a machine that duplicates the functions of the $US2895 IBM PC/XT, would it spend $US695 on a database or spreadsheet package? Probably not.

Although established market leaders such as Lotus and Ashton-Tate are able to continue selling their wares at a high price point, most others are cutting prices, even on full-featured products. For example, Adam Osborne's Paperback Software promotes its VP-Planner as a 'keystroke-for-keystroke' replica of Lotus 1-2-3, with several additional features, all for $US99.95, compared with 1-2-3's hefty price of $US495. Another 1-2-3 lookalike, Twin, is marketed by Mosiac Software. Originally priced at $US149, Mosiac recently cut the price to $US99, breaking what some observers believe is the psychological sticking point for software customers.

In just 13 months, Dac Software of Dallas, Texas sold 130,000 copies of its $US69.95 Dac-Easy Accounting, a package that competes primarily against considerably more expensive accounting packages such as one from Chang Laboratories which sells for $US500.

Even some makers of high-priced packages are jumping on the low-end bandwagon, with stripped-down versions of their breadwinners. For example, WordPerfect, publisher of a $US495 word processing package, has brought out two low-end entries — Personal WordPerfect ($US195) and Junior WordPerfect ($US95) — which, the company claims,, reach different markets and don't cannibalise sales. Low price software publishers share one major problem with their high-price cousins: shelf space. Unless a program is already established in the market, few retailers will stock it. Moreover, most salespeople are familiar with only three or four programs of a given type, and almost invariably encourage customers to purchase a higher priced one.

Random bits

The MacWorld Expo in Boston was a great success. MicroSoft released Macworks ($US295), an integrated package not unlike Apple's popular Appleworks for the Apple II family. Uncharacteristically, Apple chairman John Sculley enthusiastically endorsed the package, saying he 'found it much easier to use than Jazz' (the much-touted integrated package from Lotus). Ashton-Tate demonstrated dBase Mac, a $US495 relational database which reportedly does everything that dBaseIII does on the IBM PC. Layered Inc announced that it was shipping Insight Accounts Receivable and General Ledger software ($US595 each), integrated accounting packages for small and medium-sized businesses. A handful of other products — mostly upgrades, utilities and fonts — from other manufacturers were also introduced. END

New tricks for old mice

Dick Pountain explains how you can integrate the mouse with your applications by programming it to emulate the keyboard, using the Microsoft mouse as his example.

The mouse is rapidly progressing from being an avant-garde accessory, redolent of the research lab, to a widely used pointing device for ordinary PC users. If you doubt this, consider the fact that all the new mass-market 68000-based PCs (the Macintosh, Atari ST and Amiga) come with a mouse as standard fitting, as does the new Amstrad PC clone reviewed in this issue. What's more, any owner of an IBM PC or clone can purchase one of a choice of mice.

There has been much debate about the utility of mice in non-graphic applications with opinions ranging, as is usual in personal computing, from drooling enthusiasm to outright hatred. I fall squarely in the middle of this debate. I've been using the Microsoft mouse for more than two years now on IBM PCs, and as a result have been able to form what I hope is a balanced opinion.

The fact that the Microsoft mouse is an afterthought for the PC, and is not directly supported by the operating system, is not a bad thing. You can program the mouse to emulate the keyboard in more or less sophisticated ways using Microsoft software, which means that you can choose at what level to integrate the mouse with your applications.

My own experience has been that I started out by using large numbers of pull-down menus in an attempt to 'mousify' all the commands of my main applications (which, for a technical writer, means mainly word processors and programming systems). Over time, however, I became more and more irritated by layers of pulldown menus, and found myself stripping away features one by one until I had a set of minimal commands that could be assigned to the mouse buttons alone.

Eventually I doscovered that the only functions I really wanted to use the mouse for were moving through text rapidly (as a substitute for the cursor keys), and selecting blocks of text for moving, cutting and pasting, or whatever. For these purposes I find the mouse absolutely indispensable; going back to using the cursor keys would be as traumatic as returning to cassette instead of disk. For all the other commands, function keys are much faster and more convenient than the mouse (assuming, of course, that the application you're using is well-designed).

After passing through this minimalist phase, I discovered one more thing that I wanted to do with the mouse, namely to draw diagrams. In the sort of technical writing I do, it's frequently necessary to illustrate a point using a simple block diagram. I'm not talking here about great works of art with air-brushed shading, but merely boxes, joined by lines, containing text.

At one time I woud have had to draw such boxes separately using a pen and ruler. Later it became possible to use box graphics characters (such as those on the IBM PC and many other computers), but it was an awkward and time-consuming business to design them with the cursor keys. What I wanted was the ability to design and draw diagrams straight into my text, using my ordinary word processor, immediately the thought occurred, just as if they were ordinary words. I've achieved this in a modest but effective way using the Microsoft mouse.

MAKEMENU

The Microsoft mouse comes in two versions, one of which plugs into a serial port, the other using an interface board which plugs into an expansion slot. In both cases the mouse is coupled to PC-DOS by driver software which has to be loaded when you boot the computer. Under DOS 1 this meant running a program called MOUSE.COM, while under DOS 2 and 3 it requires a DEVICE=MOUSE.SYS statement to be put into the CONFIG.SYS file which loads external device drivers.

In neither case will this make your programs respond to the mouse unless they were designed to use it, and very few are (those are mostly CAD and

drawing programs). All that MOUSE.SYS does is to put in place the software links that enable the mouse position and status to be read via DOS. Actually doing the reading is another matter.

For the minority of people who write their own applications, mouse support can be included by reading the mouse directly. Microsoft supplies a library which can be linked to programs written in the company's C, Pascal, Fortran and compiled Basic, and many other languages like Borland International's Turbo Pascal now support the Microsoft and other mice. You can also read the mouse directly from interpreted Basica, and from assembler programs by using software interrupt 51. The mouse can be programmed in either the text or graphics mode of the PC. In text mode cursor movement will be in units of one character position, and the cursor will be a normal flashing block. In graphics mode the cursor moves smoothly by single pixels, and you can program fancy cursors (such as arrows, hourglasses, crosses and little hands) as on the Macintosh or in GEM. However, this article is not about programming the mouse at this level (the *Microsoft Mouse Manual* covers it reasonably well).

For the vast majority of people who use packaged applications, there is a relatively easy way to integrate the mouse with software that was not designed to use it. Microsoft supplies with the mouse two programs, called MAKEMENU.EXE and MENU.COM, which enable you to write programs in a high-level Mouse Menu 'language' that makes the mouse emulate keystrokes typed at the keyboard and provides a very easy way to build pull-down menus. Such programs only work, of course, in text mode; a keystroke on the IBM PC produces a character code, not a graphic object. This is fine since all the most popular PC applications, such as spreadsheets; word processors and databases, run in text mode. The exceptions are drawing programs and programs written to support the GEM or MS-Windows environments, and these should have mouse support already built-in.

MAKEMENU is actually a special-purpose macro-assembler which

accepts a Mouse Menu source program, written as an ordinary text file using a word processor, and turns it into a machine code program. MENU.COM then loads such a program and makes it stay resident, even when an application is loaded on top of it; it sits in the background reading the mouse, and translating its movements and button presses into the required keystrokes. Any application running on top of the mouse program thinks that it is receiving commands from the keyboard.

Since all applications programs are ultimately controlled by keystrokes, you can in principle do everything with the mouse, given sufficient menus. What I want to examine here are the design decisions and performance considerations that are needed to use MAKEMENU effectively. There isn't room, or the need, to describe the Mouse Menu language in full; Microsoft's manual does that well enough. Suffice to say that it has a very simple structure with no provision for looping, the only form of control being a jump to a label. However, some of the keyword commands are extremely powerful — for example, creating a whole pull-down menu, complete with all the cursor movements necessary to make selections from it.

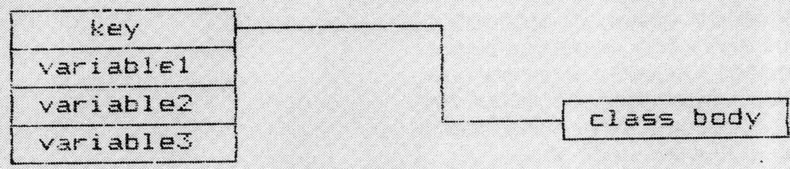


Fig 1 A simple block diagram courtesy of the mouse

```
BEGIN     ,,,left,right,up,down,4,8

left:     TYPE 0,75          ; left arrow key
right:    TYPE 0,77          ; right arrow key
up:       TYPE 0,72          ; up arrow key
down:     TYPE 0,80          ; down arrow key
```

BEGIN is the Mouse Menu statement which assigns the initial actions to the mouse, and every program must begin with one. The full syntax is:

BEGIN <left button>,<right button>,<both buttons>,<left move<,>right move>,<up move>,<down move>,<horizontal resolution>,<vertical resolution>

Program 1

Simple movement

The simplest possible mouse program is one to merely make the mouse move the cursor. Even here, though, there is a design decision to make. The first mouse program I wrote was to drive WordStar, and without thinking I chose to make the mouse movements emulate the WordStar cursor movement commands ^E,^S,^D and ^X. It worked after a fashion, but of course it did not work with any other program which used different control codes, thus forcing me to write a different program for every application I used.

The obvious (in hindsight) choice is to make the mouse emulate the IBM arrow cursor keys themselves. The mouse will then drive the cursor in any program which recognises the arrow keys, which nowadays should mean every sensible program (see Program 1).

In Program 1 I have left out the actions to be performed by the button presses, hence the three empty commas at the start. Anything written after a semicolon is comment and is ignored by MAKEMENU.

The actions to be performed are specified by giving them a name or label. For example, when the mouse is moved to the right, the action 'right' is performed. The action 'right' is defined as being TYPE 0,77, and 0,77 is the extended ASCII code for the right arrow key of the IBM keyboard (many IBM special keys send two characters when pressed). You can look up these codes in appendix G of the Basica manual.

Horizontal and vertical resolution control the 'gearing' of the mouse in each direction; that is, how far the cursor moves for a given mouse movement. Smaller numbers mean higher gearing, hence faster cursor movement. Choosing the right gearing is a matter of personal taste and the performance of your application, and must be found by experiment. The gearing 4,8 in Program 1 is rather fast and is what I use for the PC-Write word processor which is very quick. In contrast WordStar's character input routine is very slow, and a gearing of 16,32 would be more appropriate; otherwise the cursor will lag very far behind the mouse movement, and the PC's input buffer will overflow with a cacophony of beeping.

I find that for text editing it's best to use a faster horizontal than vertical gearing (hence 4,8) as this reduces the tendency of the cursor to flip unwantedly onto the line above or below the one you're moving along.

Many word processors, WordStar

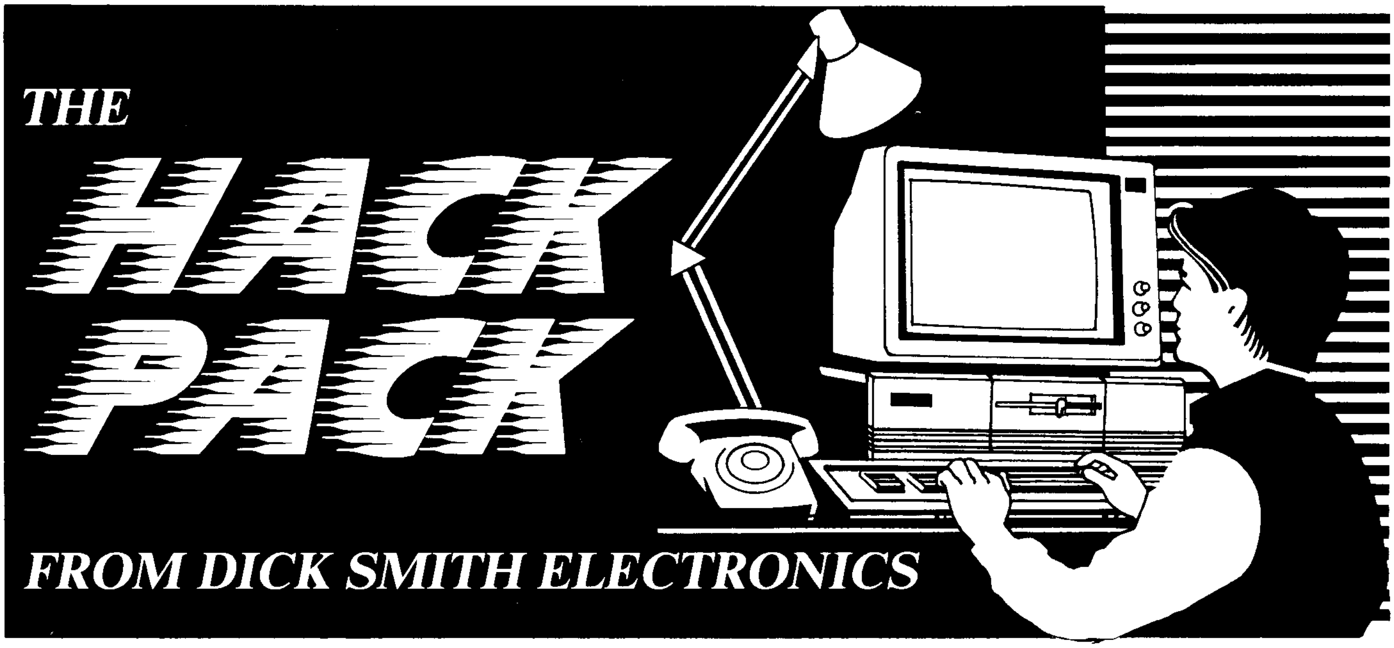
```
+--------------+
!     key      +-------------+
+--------------+             !
! variable1    !             !
+--------------+             !
! variable2    !             !        +-------------+
+--------------+             +--------+ class body  !
! variable3    !                      +-------------+
+--------------+
```

Fig 2 The crude block diagram. Not pretty perhaps, but serviceable

```
BEGIN   bmark,emark,,left,right,up,down,4,8

bmark:   TYPE 0,64              ; F6 key
emark:   TYPE 0,63              ; F5 key
left:    TYPE 0,75              ; left arrow key
right:   TYPE 0,77              ; right arrow key
up:      TYPE 0,72              ; up arrow key
down:    TYPE 0,80              ; down arrow key
```

Program 2



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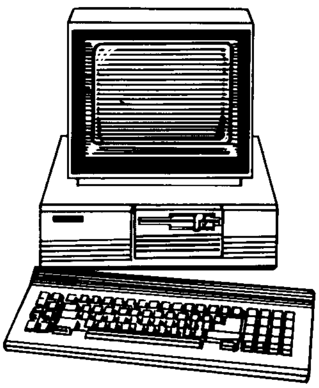

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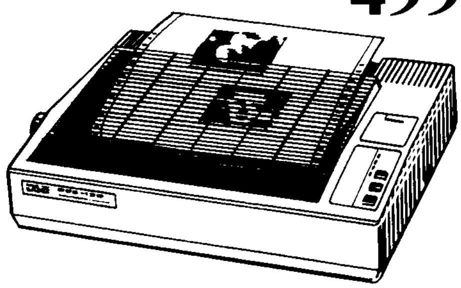

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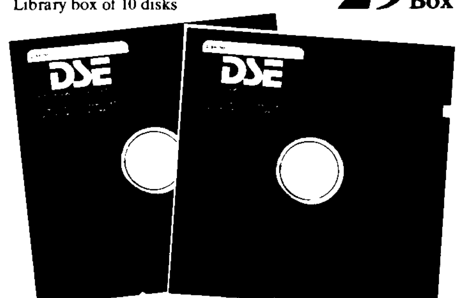

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included, are less than ideal for mouse control because they don't fill the area beyond the end of a line, or between multiply spaced lines, with space characters. You can tell if yours is one of these by seeing what happens when the cursor is moved one space beyond the end of a screen line. In WordStar it will flip instantly down to the beginning of the next line. This will drive you barmy when you use the mouse; whenever you accidentally 'mouse' too near either margin, the cursor is suddenly teleported to the opposite margin, while moving through a double-spaced document becomes a nightmare of wildly oscillating cursor movements. I solved this problem at a stroke, abandoning WordStar for PC-Write (though there were many additional reasons to do so).

To actually run Program 1, write it into a plain ASCII file (for example, a WordStar non-document file) called MYMENU.DEF. Then run MAKEMENU, and when it asks for a filename, tell it MYMENU. MAKEMENU will assemble the program (assuming you have made no typing mistakes) into a new file called MYMENU MNU. The program is installed by typing MENU MYMENU (you will eventually want to put this command into AUTOEXEC.BAT so that the mouse program is installed when you boot up). The mouse will now emulate the pressing of the four arrow keys. Only the .MNU file is executable, and the .DEF file could be deleted (assuming you never want to alter the program). The mouse program can be disabled at any time by typing MENU OFF from the DOS prompt, and re-enabled by simply typing MENU.

Selection

Program 1 completely ignores button presses, which is rather a waste. The question is — what do we make them do? In my minimalist phase, all I wanted was for them to mark a text block. So in WordStar one could, for example, make the left button perform ^KB and the right button perform ^KK. This is open to the previously raised objection that it becomes meaningless inside other applications. An alternative favoured by some is to make the buttons produce keystrokes that are used a lot, such as ESC and CR.

I chose to make the buttons emulate two of the IBM function keys, because I discovered that all the applications I use regularly are highly user-configurable (perhaps that's why I use them), so I could install them all to use these two function keys in equivalent ways and thus use the same mouse program for all. I chose F5 and F6 and set these up to perform block marking in PC-Write, Side-Kick's Notepad, the Turbo Pascal editor, PC-Forth and PC-Outline. The revised program is shown in Program 2.

This leaves only one control unaccounted for, namely the pressing of both buttons together, and any extra functions will have to be accessed through this.

Simple drawing

My first diagram-drawing program was very simple indeed. It didn't use the IBM extended graphics characters, for three reasons. Firstly, at that time I found them very inconvenient to print on my Epson printer. Secondly, there are too many characters (with all the corners and joints) to select from without using a large menu. Thirdly, and the clincher, I need to send my text via a modem using Telecom's PSS service, and 8-bit IBM graphics characters do not travel well (they tend to emerge as ordinary alphabetic characters).

Accordingly I chose to use crude 'dotty' boxes built from the hyphen character '–', the vertical bar character '| ', and the plus sign '+' for corners. The result is shown in Fig 2.

In a graphics-based drawing program like Macpaint, you hold the button down to draw. This doesn't work with a character-based Microsoft mouse program as only the actual button press event can be detected, not the state of *being held down* or released.

Another attractive design feature would have been to draw boxes merely by pointing to the diagonally opposite corners; for example, top left and bottom right. Unfortunately the Mouse Menu language has no commands for reading the current screen cursor position, or for looping, and so this avenue is barred.

I found the most effective solution was to make mouse movement itself do the drawing; moving to the left draws a line to the left, and so on, the mouse leaving a trail like a turtle. Obviously you need to be able to switch this trail off to move to another location without drawing, and so I made the right button toggle between drawing and simply moving. The left button merely types a '+' sign to make the corners. In this way I can draw a whole diagram controlled only by the buttons, with no menus required.

Now, of course, there are two different mouse modes. In the normal mode, the mouse moves the cursor and the buttons select blocks of text; in the drawing mode, moving the mouse draws lines. To switch between these modes a small menu is advisable, just to give visual proof that the switch has happened. Switching is achieved by pressing both mouse buttons together, and selecting an option from the menu (see Program 3).

In Program 3 I used the simpler of Microsoft's automatic menu-creating facilities. The structure MENU...MEND creates a pull-down menu called DRAW MODE, with the two options ON and OFF. It appears at screen row 1,, column 67 in reverse video — that is, black on white. (NB Be very careful when using MENU...MEND not to leave any spaces between the option text and the comma which separates it from its action; for example, OPTION 'ON', draw. If you do, MAKEMENU will fail to see the action and the option will have no effect; an undocumented 'feature' which caused me hours of fun).

The actions caused by choosing

```
      BEGIN  bmark,emark,switchmode,left,right,up,down,4,8

      bmark:   TYPE 0,64                          ; F6
      emark:   TYPE 0,63                          ; F5
      left:    TYPE 0,75                          ; go left
      right:   TYPE 0,77                          ; go right
      up:      TYPE 0,72                          ; go up
      down:    TYPE 0,80                          ; go down

  ; create mode switch menu

      switchmode:     MENU "DRAW MODE",1,67,inverse
                        OPTION "ON",draw
                        OPTION "OFF",restore
                      MEND


      restore:    ASSIGN  bmark,emark,switchmode,left,right,up,down,4,8
      draw:       ASSIGN  plus,move,switchmode,drawl,drawr,drawu,drawd,8,12
      move:       ASSIGN  plus,draw,switchmode,left,right,up,down,4,8

      plus:     TYPE 43,0,75                ; type +, go left
      drawl:    TYPE 0,75,45,0,75           ; go left, type - , go left
      drawr:    TYPE 0,77,45,0,75           ; go right,type - , go left
      drawu:    TYPE 0,72,124,0,75          ; go up, type | , go left
      drawd:    TYPE 0,80,124,0,75          ; go down,type | , go left
```

Program 3

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options ON and OFF are defined in the statements 'restore' and 'draw' which use the ASSIGN command. ASSIGN works exactly like BEGIN but inside a program rather than at its beginning; in other words, it reassigns the functions of the mouse.

- 'restore' does exactly the same as BEGIN, setting the mouse back to its original functions.
- 'draw' sets the mouse movements to produce dashed lines. Note that as well as typing the '–' and '| ' characters, some cursor movements are needed to keep the motion consistent. Typing a character normally advances the cursor one place to the right and we have to undo this motion with a 'go left' character.
- 'move' allows you to move without drawing, and is toggled by the right button (because 'draw' calls 'move' and vice versa).

To draw effectively with this program, some conditions need to be met. Your word processor must be set to Overwrite rather than Insert mode, otherwise a nasty tangle results. Similarly, automatic reformatting, if you have it, must be switched off. Finally, you need something to draw on. As pointed out earlier, editors like WordStar do not actually fill a gap in the text with spaces. What looks like a gap on the screen is a 'black hole' consisting only of invisible newline characters at the left margin, and the cursor cannot enter it. With editors of this kind you will need to create a 'canvas' of real space characters (as produced by the spacebar) to draw on. The simplest way to do this is to create a special file which contains, say, 30 lines of spaces, and import this into your document (for example, with **^KR**) whenever you want to make a diagram. This is another good reason to prefer editors such as PC-Write which fill with spaces.

```
BEGIN  bmark,emark,dron,left,right,up,down,4,8

bmark:      TYPE 0,64              ; as above
emark:      TYPE 0,63
left:       TYPE 0,75
right:      TYPE 0,77
up:         TYPE 0,72
down:       TYPE 0,80

dron:       MENU "DRAW MODE",1,67,inverse
              OPTION "DASH",draw
              OPTION "GRAPH",graf
            MEND

droff:      MENU "DRAW MODE",1,67,inverse
              OPTION "OFF",restore
            MEND

draw:       ASSIGN  plus,move,droff,drawl,drawr,drawu,drawd,8,12
move:       ASSIGN  plus,draw,droff,left,right,up,down,4,8

plus:       TYPE 43,0,75           ; as above
drawl:      TYPE 0,75,45,0,75
drawr:      TYPE 0,77,45,0,75
drawu:      TYPE 0,72,124,0,75
drawd:      TYPE 0,80,124,0,75

graf:       ASSIGN  cornmenu,gmove,droff,grafl,grafr,grafu,grafd,8,12
gmove:      ASSIGN  cornmenu,graf,droff,left,right,up,down,4,8

grafl:      TYPE 0,75,196,0,75     ; go left, type - , go left
grafr:      TYPE 0,77,196,0,75     ; go right, type - , go left
grafu:      TYPE 0,72,179,0,75     ; go up, type | , go left
grafd:      TYPE 0,80,179,0,75     ; go down, type | , go left

restore:    ASSIGN  bmark,emark,dron,left,right,up,down,4,8

cornmenu:   POPUP 12,38,inverse
              TEXT "┌┬┐"
              TEXT "├┼┤"
              TEXT "└┴┘"
              SELECT 1,1,1,corner1
              SELECT 1,3,1,corner2
              SELECT 3,3,1,corner3
              SELECT 3,1,1,corner4
              SELECT 2,3,1,corner5
              SELECT 2,1,1,corner6
              SELECT 3,2,1,corner7
              SELECT 1,2,1,corner8
              SELECT 2,2,1,corner9
            PEND

corner1:    TYPE    218,0,75       ; after typing one of these corner or
corner2:    TYPE    191,0,75       ; junction characters, the cursor
corner3:    TYPE    217,0,75       ; remains in the same place.
corner4:    TYPE    192,0,75
corner5:    TYPE    180,0,75
corner6:    TYPE    195,0,75
corner7:    TYPE    193,0,75
corner8:    TYPE    194,0,75
corner9:    TYPE    197,0,75
```

Program 4

Drawing with graphics characters

Eventually I succumbed to the desire to draw diagrams with IBM graphics characters as well as dashed lines (largely because I found a convenient way to print them). The program for this is rather more complex than the last (see Program 4). Just to draw single boxes you need 11 different characters (horizontal and vertical line segments, four corners and five junctions) and if you wanted the double lines too, the number escalates tremendously. Obviously these cannot all be accommodated on two buttons, and so a menu becomes necessary.

Playing with nasty, long, thin pull-down menus convinced me that they were much too difficult to select from accurately, and I decided the most elegant solution was to fit the nine corner and junction characters together to make a window-pane shaped 'menu':

Any of the nine characters can be chosen from this 'menu' by moving no more than four places. The Mouse Menu language's POPUP...PEND structure creates such multi-column menus very simply. As before, mouse movement draws horizontal and vertical lines, but now the left button summons the window-pane menu to choose the proper corner or junction character.

The DRAW MODE menu now offers a choice of two drawing modes, and a second menu is summoned from either mode to switch drawing off.

Enormously complex mouse-driven systems can be created with the Mouse Menu language, and if you pay sufficient attention to the ergonomics they can be made easy to use without a mess of menus. My latest creation allows me to 'paint' in four shades of grey tone as well as drawing boxes, but I'll spare you that one for now!

END

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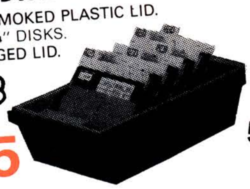

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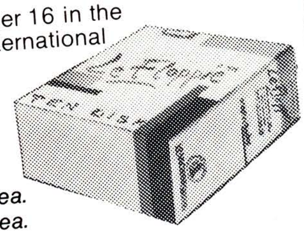

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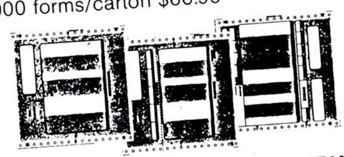

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Ready, willing & able

A project funded by some of the leading names in Australian industry is achieving some success in finding computer related employment for disabled people. Kester Cranswick reports.

Disability can seem the end of the employment road for many people. Whether it is an accident that wreaks permanent damage on the body, or a genetic inheritance, present from birth, the disabled have often found themselves unemployed and unemployable.

Fortunately, the computer is able to bring disabled people back into the workforce. There are organisations that can train the disabled, equipping them to perform tasks that are immensely valuable in the office. And, what is even better, many employers are finding that disabled people are better at certain types of jobs than physically healthy people.

Evidence to support this view comes from research into the subject of autism, and how computers are able to help overcome this handicap.

Autism is a severe mental handicap in which children become extremely self-preoccupied. They are unable to communicate in a normal manner with other human beings.

What researchers, such as Dr Roger Coldwell of the Royal Melbourne Institute of Technology, are discovering, is that autistic children respond very well to computers. It seems they can relate to a machine because they know they are in total control of it.

Coldwell cites examples. One nine year old girl, after two sessions at a computer, grabbed the mouse from her mother and proceeded to show her how to use the graphics system. In the next session, she occupied the centre seat, and took over from her mother. In another case, a 12 year old boy, unable to concentrate for longer than 35 minutes, had to be dragged away from the computer after two and a half hours at the keyboard.

From his research Coldwell concludes that autistic people would make very good keyboard operators. "An autistic person would work on oblivious to distractions. They wouldn't feel lonely working at a terminal on their own either," he says. Their ability to relate to a computer is a positive asset.

Autism is something people are born with. Disability can strike at the prime of life too.

Take the case of Kevin Cosgriff. He had been working for ICL as a bureau programmer and in customer support since 1966. Then, in 1980, he was just completing a marathon 500km flight in a glider when he hit a violent front, and the glider plunged into the ground. "I don't remember anything other than that something grabbed the glider," he recalls.

Cosgriff was in hospital for four months, and his injuries left him in a

wheelchair, paralysed from the waist down. He spent a further eight months undergoing rehabilitation and learning to adjust to his disability.

Now he is back at ICL, working as a special projects manager. The new ICL building in Queens Rd, Melbourne, has ramps instead of stairs, so he can get around the place and he parks his car on the site of the building. He plays a vital role in the organisation. "There was no appreciable effect on my work other than the time off," he says.

Cosgriff is lucky. His job can be done at his desk, and he has the technical knowledge to carry it out. His disability has not prevented him carrying out his work.

But what about all the disabled people who don't know an Esc from an Alt key?

There is an Australian organisation that specialises in teaching them new skills. It is called Nadow, but was once

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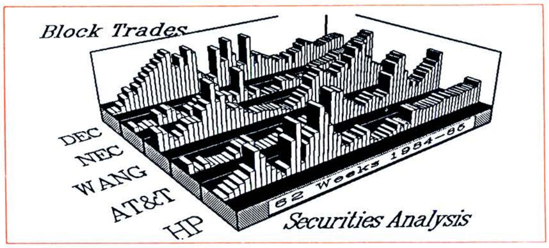

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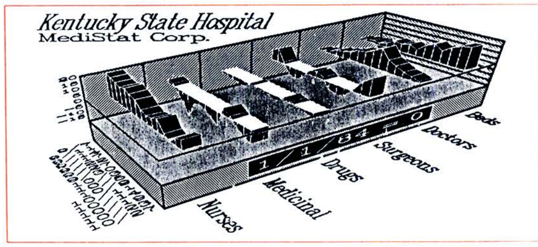

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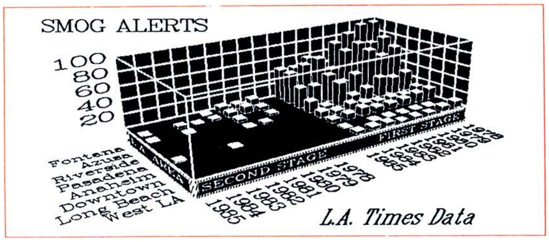

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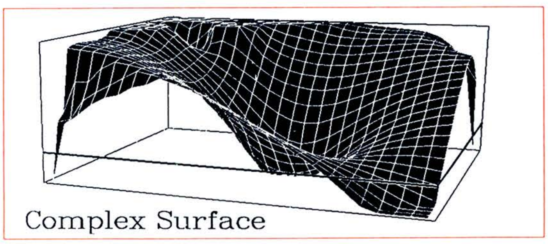

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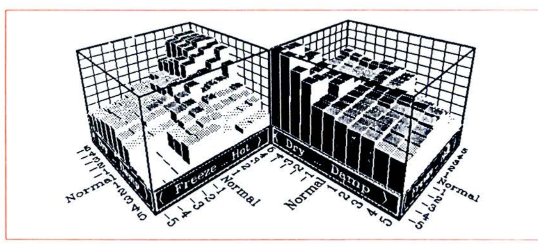

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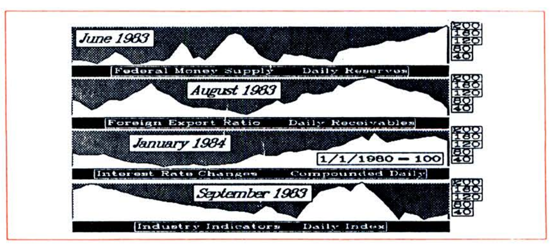

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known as the National Association for Training the Disabled in Office Work, and is based in Sydney. Nadow is backed by many of the leading names in Australian industry.

Nadow has a philosophy, and it has remained unchanged since 1965. Adrian Bradley, Nadow's training officer sums it up by saying the goal is "to make people marketable in the current labour force."

In Australia, as in most other Western countries, there is a chronic shortage of people skilled in the use of computers. It is one of the few job areas where employers cannot discriminate, so acute is the staff shortage.

Even so, there is a credibility problem, and Nadow has worked hard to give the disabled credibility in the eyes of employers. To that end, it has the backing of such companies as IBM, Hewlett-Packard and ICL, in the computer field, and AMP, Price Waterhouse, Rank Xerox, James Hardie, BHP, Caltex, Amatil, Castlemaine Tooheys, George Weston and the State Building Society. All these organisations have provided monetary assistance to Nadow, and taken in Nadow-trained people.

According to Bradley, it works like this. "We rely on these companies to create a vacancy where trainees can work and gain recognition of their aptitude, skill and motivation. If, at the end of the training they get a work reference, signed by the company DP manager, there's your credibility. You can have a reference from God and employers will question it. DP managers tend only to believe other DP managers."

Bradley is not one for the soft approach. "We hit the employer behind the desk with the fact that if they're going to be prejudiced, they're going to feel bloody guilty about it. If the person can do the job, they should be given the opportunity.

"We're not talking about affirmative action, we're not talking about quotas, we're not even talking about sympathy. We're only talking about a fair go," he says.

The term disabled covers a wide range of injuries. It can range from a back injury to epilepsy to partial or complete blindness, as well as embracing the more widely recognised disabilities such as loss of limbs or damage to the central nervous system, resulting in quadriplegia or paraplegia.

If you listen to Bradley, you'll soon discover that disability is no small problem. Back injuries are far and away the most common. He says that one in six men who are working in semi-industrial settings will have a minor or major back injury by the time they are 40.

Bradley differentiates between disabled people who have had their disability all their lives, and those who were struck down when they were adults.

"Disabled people in the former group have often adjusted to or accepted their limitations, though they have differentially socialised," he says, meaning that their social contacts are in the world of the disabled, or within the family and close friends.

"The other group has a completely different set of issues. We don't have to teach them the idea that you have to work to look after yourself. They know that. What they're trying to do is adjust to their disability."

He is not of the opinion that a disability makes someone unemployable. "An injured back, or disability, doesn't make any difference to their mental capabilities," he says.

"You have to remember that only one in seven has a visible disability that seriously impairs employability. Someone with a knee problem, someone who's a controlled epileptic, someone with a vision or hearing problem — none of these disabilities can be seen and there's no wheelchair involved. They are, nonetheless, disabilities."

To be eligible for a place in Nadow, the qualifications are simple: you have to be unemployed, medically able to work in an office or clerical environment and have average intelligence.

Some 80 people start a Nadow training course each year. "The people we get here are motivated. As I tell them, there are only three things they need to be accepted in this program. They are motivation, motivation and motivation. It's hard enough to get a job these days, let alone if you've got a disability and have to completely change job direction," says Bradley.

"If they haven't got motivation, I tell them to go home, watch the midday movie, get on the dole or pension and take the easy avenue. Only five per cent who walk in the door walk right out again."

Those who are accepted into a Nadow scheme get one of two types of scholarship. A computer scholarship, valued at $7,500, means 12 months of comprehensive training on computers, both at Nadow and on the job. A general clerical scholarship, which runs for just six months, covers modern office and clerical procedures.

On the clerical course, students are trained on two IBM PCs, an Apple IIe and a Hewlett-Packard Touchscreen 150. Sydney Smith, Nadow's computer

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training manager, says that students are not trained to use any particular software packages.

"The micros are used to simulate VDU experience. They call up established files, check data, make entries and so on. There is no point in training on particular packages, as the student may not be using that software when he or she joins the workforce," he said.

Computing students are trained in Cobol. They start with an introduction to the raw concepts behind computing, software and hardware. Then, using two IBM terminals on-line to an IBM 3081 mainframe at Caltex, they are given a course in Cobol. It involves writing 11 programs.

The real training starts on the job. Nadow students are given six months on the job training in the DP industry. Clerical students get three months on the job training. "On the job training gives students confidence, competence and credibility,' says Smith.

Nadow has set up a group to monitor what the labour market needs. Called the Nadow Computer Training Committee, it enables associate companies to contribute advice, in addition to their time and money. This means that Nadow trainees are kept as up to date as possible with current trends in the computer industry.

The first software company to join with Nadow was Computations. David Halliday, Computations' marketing manager, is convinced other companies need to get involved.

"My gut feeling is that the industry is probably largely unaware of Nadow's existence. It is probably no more aware of Nadow than the average man on the street.

"Companies are now supporting the growing trend in hiring disabled people, but, unfortunately, it's not growing at the rate it should," said Halliday.

There are 16 companies currently associated with Nadow, and room for four more. Nadow is limiting the number of associate companies so that the size of the NCTC does not get out of hand, and so that trainees can be more easily monitored.

Bradley is optimistic about the future. Things will get better. More and more disabled people will be trained and placed in jobs where they can move from being a tax dependent to being a tax-payer. Recognition of potential in disability is happening."

However, there is still a way to go before chronically disabled people, who are confined to home, can be accepted into the workforce. In the UK, there is a scheme that trains home workers to use a personal computer, and finds them positions in the workforce. It is being funded by the Department of Trade and Industry to the tune of £500,000, and is run by a London company called IT World. It has already placed 65 disabled people in jobs.

Smith doesn't believe the Australian employment market is ready for this yet. Still, the time may come when any disabled person able to use a keyboard can find work. There is certainly a demand for skilled operators, and the computer offers the disabled a chance to get back into the workforce as productive, enthusiastic individuals. END

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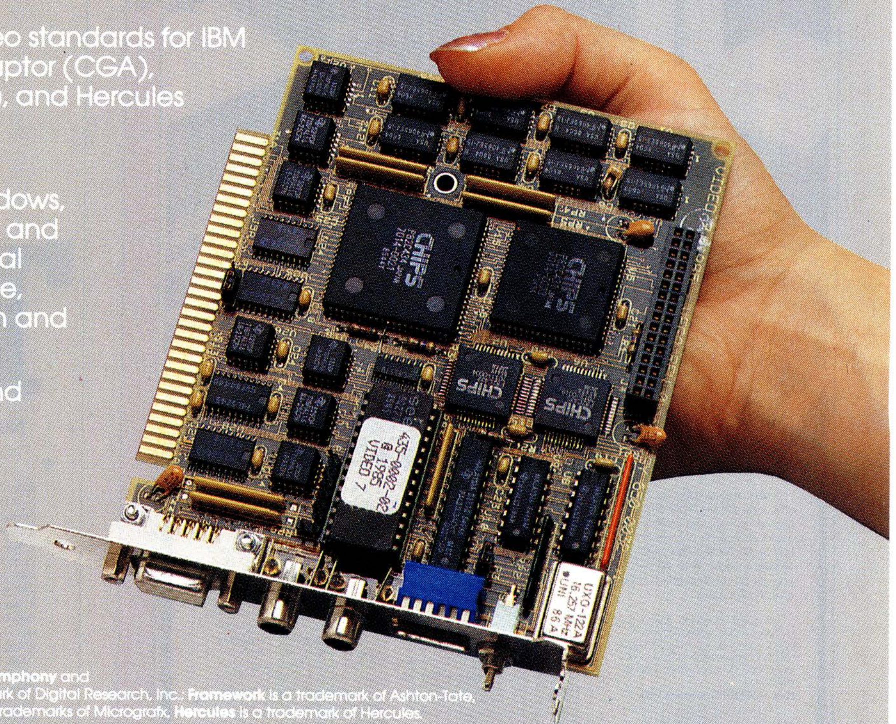

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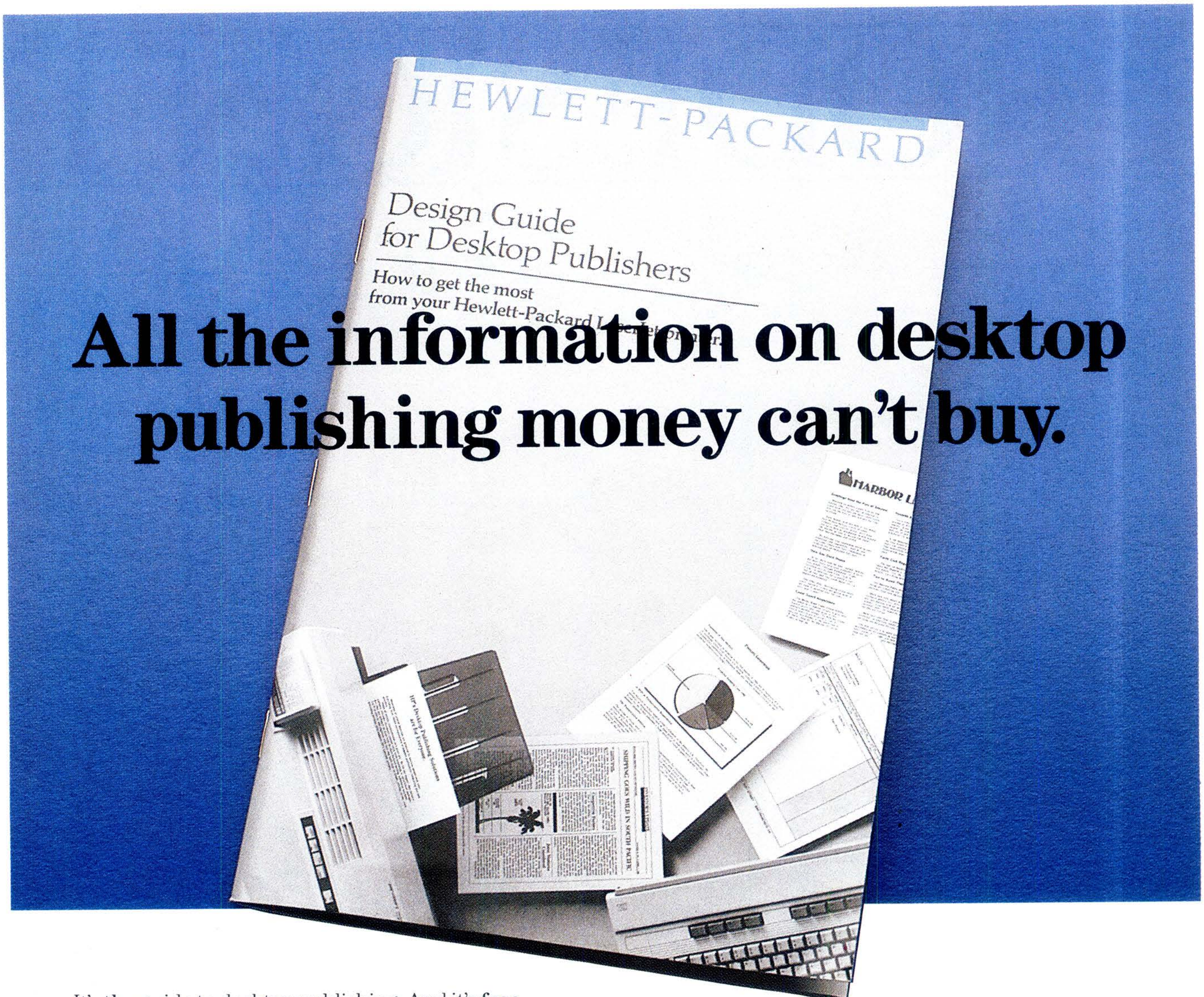

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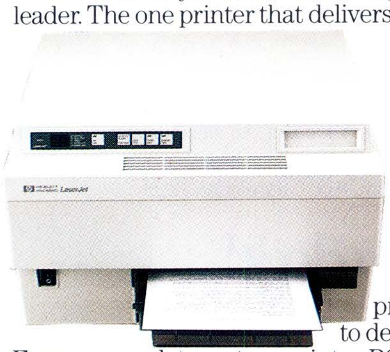

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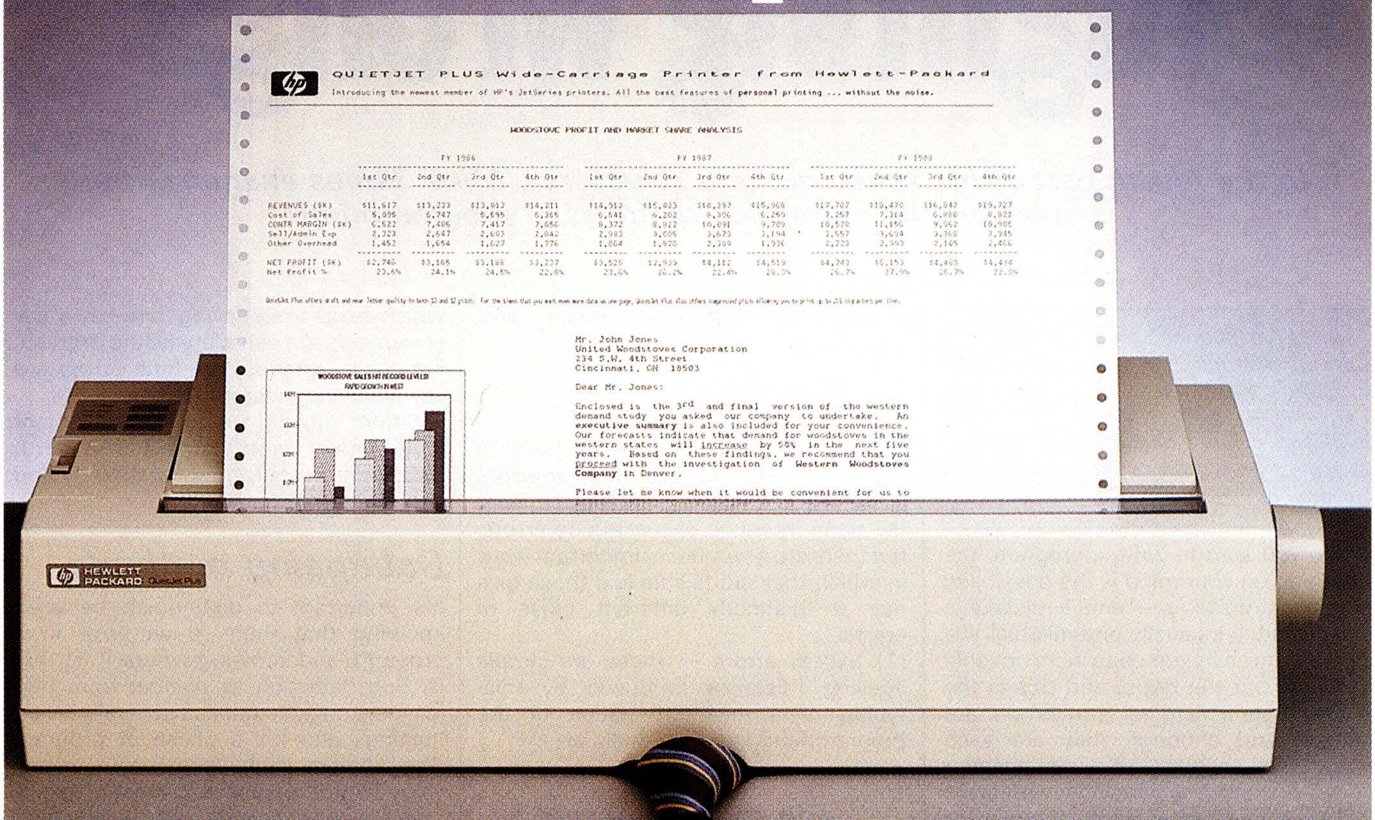

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Righting wrongs

In the fourth part of his series on data structures, Mike James examines the detection and correction of errors in programming.

This is part four of a six-part series on programming methods and the creation of programs. Parts one, two and three appeared in the July, August and September issues respectively, copies of which are available from APC Back Issues.

When you start to write a program, the last thing on your mind is the possibility of making mistakes — until a mistake is discovered, it's usually unthinkable! We all program as if perfection were not only possible, but the norm, and this is the programmer's cardinal sin. Errors are natural, and although they are each individually avoidable, it's very nearly a certainty that some parts of any program will have to be labelled as incorrect for one reason or another. Therefore, *en masse,* errors are not avoidable.

Of course, if you're thinking in terms of errors as nothing more than spelling mistakes (syntax errors in the jargon), you may be surprised by the assertion that errors are unavoidable because this particular class of error is easy to stamp out. But this is nothing more than saying that a piece of written text is correct because it has been processed by a spelling package — it can be correctly spelt, but can still be mostly nonsense. It's important to distinguish between simple errors of syntax and errors of meaning, expression and specification.

The current state of the art is that we have a fairly standard set of methods for testing and correcting programs, which have been in use for some time, and we are now turning our attention towards the more difficult problem of writing programs which are better at coping with the inevitable errors that they contain. Since the SDI (Star Wars) initiative, the whole subject of fault-tolerant programs has become much more urgent. It's proposed that a gigantic program should be written that, by the very nature of the situation it deals with — that is, a nuclear war — cannot be fully tested. In the future, our continuing existence may depend on the fault-tolerant programming.

Making errors

One of the most difficult questions to answer is: 'How do programming errors arise?' Programmers always start with the good intention of making no errors, but there are a number of important ways in which they are fallible and these give rise to distinctly different types of errors:

(1) Syntax errors — these are simple spelling mistakes produced by mistyping or a misinterpretation of the programming language manual.

> *'The most common method of bug location is the "just looking method". A print-out is obtained, and the programmer sits and looks at it . . .'*

(2) Run-time errors — these are errors that only become apparent when the program is active. Run-time errors can occur because of some unforeseen, and hence uncatered for, condition or because of the type of inputs a program is presented with.

(3) Specification errors — these are failures of a program to meet its specification. In other words, the program may, in the usual sense, work, but it doesn't do what it was intended to do. It's possible to have a complete specification error where the program solves the wrong problem, but the shortcomings of a program are usually only partial.

Of the three types of errors, run-time errors are the most varied and the most difficult to characterise. They are also potentially the most devastating, occurring at any time during the life of the program and with consequences which range from having to re-key a few commands to a complete failure or crash. For these reasons, run-time errors are currently the most important.

Before moving on to the subject of fault-tolerant programming, it's worth recounting current testing and debugging methods.

Debugging methods

It's important to distinguish between knowing that there is an error in a program, and knowing *where* it is: that is, bug detection as distinct from bug location. bug detection is generally called 'testing', and it's a phase of program development that is usually undervalued. Another problem is that testing is about proving that your program *doesn't* work, but most programmers test programs to prove that they do work! Even if you're prepared to attack your program in the spirit of making it fail, there's always the psychological barrier against showing that the product of your own intellect is, in fact, flawed. This is the main reason why some people are better at testing than others, and why it's better to use someone other than the person who wrote the program to test it.

To test a program fully, it's necessary to supply data that will take it through every possible route, and this is difficult. The number of routes through even a smallish program is enormous. Not only do you have to ensure that every route has been tested, you also have to test the program's response to extreme data values. Of course, the trap in this simple idea is in the word 'extreme', because what is extreme data depends on the situation: often included in the extreme data category are large numbers, negative numbers, zero, character data, control characters, and so on. But what constitutes appropriate test data relies on the judgment of the programmer to choose data that is likely to cause the program to malfunction — remember, the purpose of testing is to show that the program doesn't work.

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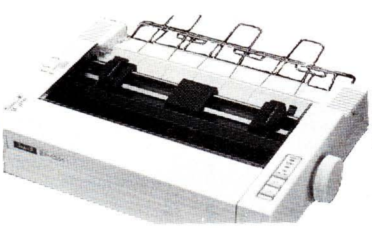

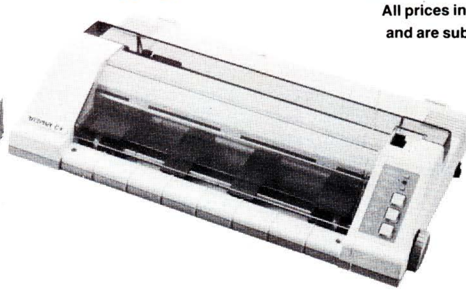

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It's usual for testing to proceed as the program is developed — stepwise testing is a natural partner to stepwise refinement (see last month's article) — but there's still a need for a final testing phase. Stepwise testing picks up problems as the program is being developed; final testing makes sure that the program is fit to be used. Although it sounds as though we know how to test a program, this is only a theoretical certainty; in practice, testing is still a matter of judgment about how best to use the limited time available.

When you have determined that there's a bug in a program, the next step is to locate it. The most common method of bug location is the 'just looking method'. A print-out is obtained, and the programmer sits and looks at it for a few minutes. This is a very effective method for a great many simple bugs. Indeed, often the bug becomes obvious in the time it takes for the printer to produce the listing! (This is one of the main reasons that most printer listings are thrown in the bin almost as soon as they are produced. Printing a program out is one of the standard ploys used by programmers to give the impression and the comforting feeling that something is happening while they stand about and think for a few moments!) The trouble with just looking is that it's often the only debugging method a programmer knows, and it's a property of the method that if it's going to work, it works in, at most, a few minutes. There's no point in staring at a listing into the small hours of the night, cup of coffee in hand. Such tales of all-night debugging sessions are often an indication that the programmer involved knows little of logical fault finding.

Debugging is an activity that is just as logical as programming, and it's based on gathering observations about how the program is working and comparing this with information about how the program *should* work. This 'predict and compare' method has been in use as long as there have been programmers to create bugs. There are only two things that determine the behaviour of a program: the path taken through the statements; and the values stored in the variables. If you can predict the path through the program and the values of the variables at each point, then by comparing these with the actual route that is taken through the program and the actual values of the variables, the bug can be located at the first place that there's a discrepancy between prediction and reality.

This procedure is simple in principle, but in practice there's the problem of gathering data on how the program works. This was partially solved many years ago by the first assembly language programmer by careful use of *breakpointing.* A breakpoint is a temporary halt instruction which allows the programmer to verify the program's behaviour so far. Ideally, a breakpoint instruction should print a message indicating where it is, and allow the programmer to examine the contents of variables before restarting the program.

'Bugs should be reduced to an acceptable level, but it's better to admit that zero bugs is an impossible goal and try to find ways of dealing with ones left in a finished program.'

The nearest thing Basic has to a breakpoint is the Stop command, which will usually print a message to the effect 'Stopped at line xx' and will also usually allow direct printing of variables. Where the STOP instruction sometimes lets you down is in the way it allows a restart. Some versions of Basic have a CONTINUE command; in others, you have to use an explicit GOTO instruction to get things moving again. (The BBC Basic STOP command doesn't even allow you to restart successfully using a GOTO because it forgets all about any incomplete FOR loops, procedures, and so on, so negating its usefulness as a breakpoint command). Although breakpointing is the fundamental method of debugging, there are now many sophisticated debugging aids that will run a program, trace the path taken and print diagnostic information. However, no matter how sophisticated a debug package you are using, the principle of predict and compare is still the basis of locating bug.

The law of bugs

It's naive to assume that you can remove all the bugs from a program, no matter how much time you're prepared to devote to effective testing and debugging procedures. Although the

perfect program is a logical possibility, it's a practical improbability. Bugs tend to die out slowly rather than give up *en masse* under pressure of debugging methods; this observation may seem unreasonable, but it's undeniable. Even programs which have been in use for long periods of time (10 years, say) still reveal previously undiscovered bugs. As you might expect, the time interval between such bug discoveries does increase with the life of a program, but the severity of such bugs does not decrease. It's still possible — and common — to discover fairly major bugs which cause the program to fail completely after a long and otherwise useful life.

Such long-term bugs are generally concerned with the coincidence of events, each of which is quite rare. For example, it might be that an operating system has been successfully tested with three users logged-on for many years, but it's only when three users log-on at precisely the same moment that a bug which crashes the whole system is revealed!

Another type of bug which tends to show late in the life of a program is the bug which occurs often but which usually has only a small effect. For example, a word processor might contain a bug which causes the loss of a character on the boundary of a storage block — for example, every 32k characters. Normally, the loss of one character in 32k isn't noticeable, but if that character happens to be a text formatting command, then the error is easily spotted as the remainder of the document will be incorrectly formatted.

All of this is not an excuse for not trying to eliminate bugs from a program. Bugs should be reduced to an acceptable level, but it's better to admit that zero bugs is an impossible goal and try to find ways of dealing with the ones left in a finished program.

Inside information: flags

The most common use of a variable is to hold the result or raw material of a calculation or other data manipulation: that is, variables generally hold data values which the program works on. There is, however, another use for variables that is often ignored, especially by beginners. A *flag* is a variable that is used to indicate the state of some part of the program or of some external event. For example, a subroutine can return a flag variable, ERROR, which will be set to zero if no error occurred, and one if an error of any kind occurred. Flag variables are special because the only legal operations on a flag are to set or reset it, and to test it within an IF statement. In this sense, flags are message carriers within a program. There are two-state flags which can only be in one of two states: yes/no, on/off, stop/go, and so on. Two-state flags are easy to use if their values are either true or false — that is, the values the system uses to represent the result of a true or false condition. Such flags are called Boolean or logical flags, and they make testing very easy. For example, if ERROR is a logical flag that's true when there's an error, you can write:

```
IF ERROR THEN GOSUB error handler
```

There are also multi-valued flags which can be used to indicate which of a number of possible states the program is in. For example, ERRTYP is a multi-valued flag if it records a number which indicates the type of error that has occurred. In more sophisticated multi-tasking applications, flags are transformed into an advanced data type called semaphores which are nothing more than flags with restrictions on how and when they can be set and reset. Don't be fooled into thinking there's anything much more complicated than a simple flag!

> *'Programmers always start with the good intention of making no errors, but there are a number of important ways in which they are fallible . . .'*

Exceptions

Given that you have applied sufficient effort to debugging, the only thing that you can do to improve your programs is to incorporate lines of code that are designed to cope with errors. The trouble with this idea is that if you could anticipate the exact nature of the errors and hence cope with them, you could alter your program to eliminate them. It seems that we have an impossible task, but there are ways of writing programs which guard against things going wrong, even if you aren't sure of the whys and wherefores of what *might* go wrong. This is called *defensive programming* and there are many varieties. For example, at the start of each subroutine, you might state certain logical relationships which have to hold between the variables before the subroutine is executed. This, of course, avoids the question of what should happen when an inconsistency is detected and this is the really difficult part of fault-tolerant programming.

These days, the most-used method of defensive programming is based on the idea of an *exception.* An exception is an unusual condition that arises during the execution of a subroutine. Once an exception has been detected, control is passed to an *exception handler,* a chunk of program designed to do the right thing when the exception is detected. For example, the expression A/B can only cause a problem in one of three ways: either the result is too small or too big to be represented; or B is zero and the division cannot be performed. In non-tolerant systems these correspond to 'underflow', 'overflow' and 'division by zero' errors, and these are usually fatal — that is, they cause the program to stop running.

In newer languages such as Ada, such errors can be made to cause an appropriate exception handler to take control rather than crash the program. Notice that none of this implies that we know the deeper reason why A/B isn't computable — for example, that a user has typed in an appropriate value or a hardware failure has occurred. It's enough to detect the immediate problem that would normally result in the termination of the program. What the exception handler *should* do is, if course, a different question, and this does depend on the role that the calculation which caused the error plays in the rest of the program. It might be enough to print an appropriate message and then return to some earlier point of the program, or it might be absolutely essential to stop the program from continuing.

Most versions of Basic contain a primitive exception-handling statement — ON ERROR GOTO or ON ERROR GOSUB. This statement causes the transfer of control to a subroutine should any error occur while the program is running. Most Basic programmers use this statement once at the start of a program to cause all errors to transfer control to a single, all-powerful error-handling routine. This is, in fact, not the best way to organise things — it's too complicated to deal with all possible errors in one routine. It's much better to follow the example of Ada and guard each subroutine with its own exception handler. That is, instead of having one ON ERROR statement at the start of a program, each subroutine should start with an ON ERROR statement which

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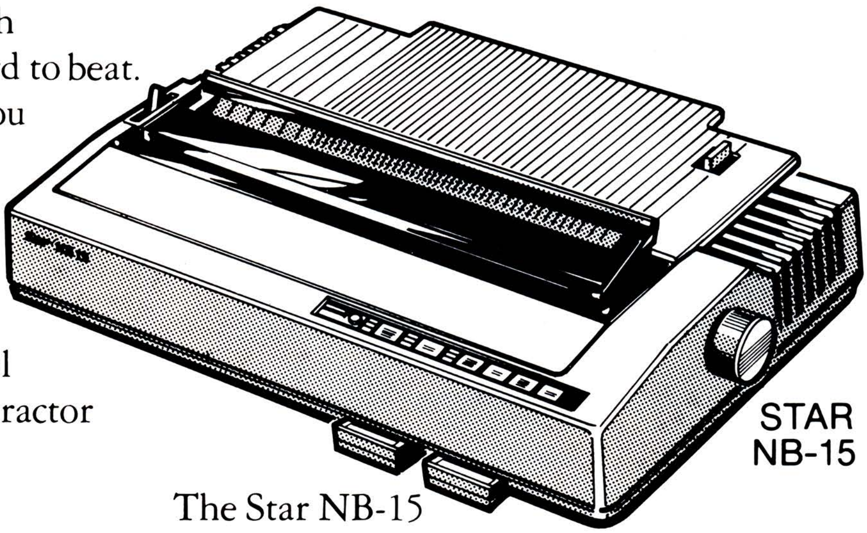

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names an error-handling routine for the type of error that might be expected from that subroutine. For example, if a subroutine is concerned with opening a file, then its error handler should deal with the possibility of 'No such file', 'Disk error', and so on, and not so much with arithmetic errors.

> *'We all program as if perfection were not only possible, but the norm, and this is the programmer's cardinal sin.'*

The introduction of exceptions and exception handlers effectively extends the principle of modular programming to make it fault-tolerant. In fault-tolerant modular programming, each module is composed of two parts : the part that does the normal work; and the exception handler. Unfortunately, exceptions are more difficult to handle than this simple-minded approach suggests.

Structure disruption

In the same way that many high-level languages inherited the primitive constructs of the underlying assembly language, so exception handling is modelled on the hardware concept of an *interrupt*. An interrupt is a transfer of control without an explicit transfer statement at the point in the program from which control has been transferred. Usually, an interrupt is a transfer of control, initiated by the hardware, from

Answer to creative challenge three

If you sit down and write a program to draw a face as one long list of instructions, you'll be doing a great deal of unnecessary work; and when it comes to changing from rectangles to circles, the amount of work involved makes it almost easier to start from scratch. The best solution is to write a program using a subroutine structure that reflects the structure of the object which you are trying to draw. For example, at the top-most level of the hierarchy:

```
GOSUB 1000: REM DRAW FACE OUTLINE
GOSUB 2000: REM DRAW EYES
GOSUB 3000: REM DRAW MOUTH
GOSUB 4000: REM DRAW EARS
END
```

The subroutines at the next level — that is, 1000, 2000, 3000 and 4000, should in the same way call other subroutines to draw their specified 'sub-object'. For example, subroutine 1000 might be something like:

```
1000 REM DRAW FACE OUTLINE
1010 X=50:Y=50:GOSUB 5000:REM DRAW RECTANGLE
1020 RETURN
```

Subroutine 5000 is a 'low-level' subroutine which actually does some work — that is, it draws a rectangle. Notice the use of X and Y as input parameters. Constructing the program in this way makes it easier to complete, and easier to modify and re-use. For example, to convert to a face drawn using circles, it should only be necessary to alter the definition of subroutine 5000 — usually a matter of one or two lines of code.

any point in the program to a specially-written interrupt handler. In the same way, an exception is a transfer of control, without an explicit transfer statement, to an exception handler.

It has long been known that interrupts are difficult to work with due to the way that they ignore the hierarchical structure of the program, and exceptions are just as difficult for the same reason.

Some programmers argue that exceptions are an unnecessary idea because they can be replaced by explicit conditions for the execution of a statement that might cause an error. For example, instead of worrying about division by zero exceptions, you could program every piece of arithmetic as:

IF B<>0 THEN C=A/B ELSE error handler

The trouble with this is that it ignores the fact that errors generally disrupt the structure of a program. For example, if you are deep down in the hierarchy and a divide by zero error occurs within a subroutine, there's generally no point in going on with the subroutine, nor with RETURNing and continuing with the subroutine that called it, and so on, back up to the top-most level. When an exception occurs, it usually requires an out-of-the-ordinary sequence of events and hence a different sequence of subroutine calls to correct it.

It's this structure disruption that makes an exception an exception and not something that's part of the normal operation of the program. Currently, we build programs considering only their expected operation, and this is reflected in the hierarchy of subroutines built up by top-down structured programming; when something goes wrong, this hierarchy is totally inappropriate, and the best we can hope for is a restart at another point in the hierarchy. For example, if division by zero is encountered in a subroutine, then there's no point in ending the subroutine normally and allowing control to pass through the hierarchy in the usual way, because the subsequent subroutines are probably going to make use of the result produced by the subroutine which has the error. Instead, what is needed is a restart at some earlier point in the hierarchy, perhaps at a subroutine that reads in the data which the subroutine with the divide by zero error uses.

The usual way of transferring control to an earlier point in the hierarchy is by way of a GOTO statement that ignores the structure of the program and transfers control back to the top-most level of the hierarchy — this is often referred to as a 'long GOTO statement'. In many versions of Basic, this long GOTO is achieved by use of the RESUME command to exit an error-handling routine. The use of the long GOTO statement is clearly against the principles of structured programming, but the only alternative is to build-in tests following every subroutine call that will detect an error and automatically return to the next level up, so automatically returning control all the way back up to the top of the hierarchy. For example:

```
  start of subroutine
GOSUB 2000
IF ERROR THEN RETURN
rest of subroutine
```

This kind of programming is tedious and complicated, and there's something to be said for recognising and making clear a situation that disrupts the normal structure of the program. The fact that error conditions disrupt the natural structure of a program has led many a programmer to claim that structured programming is itself inadequate. This is not the case. For the most part, the structure of a program should reflect its normal operation, but when something goes wrong it should be possible to make transfers that ignore its structure. It now seems clear that this is necessary, but the best way to do it is far from clear. Exceptions (and exception handling) is the best method we have at the moment, but it doesn't seem good enough to make Star Wars software sufficiently fault-tolerant to be trustworthy.

Next month: repetition

END

Creative challenge four

This month's creative challenge can be posed as: 'How do you stop a program?' Given that you are convinced that you should use top-down structured programming to construct a program, what is the proper way of bringing a program to a halt if the condition that stops the program is detected by a subroutine very low down in the hierarchy? For example, if you are writing a games program and have a subroutine 9000 which asks the user 'Another Game Y/N', what should this subroutine do if the answer is N?

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Knowing whether some particular statement is true or false is an essential element in most areas of decision making. An obvious example is computer programming — consider just how often a program contains code which is equivalent to: *if* such and such is *true then* do whatever.

Often we know the veracity of a statement or can discover it merely by looking in the right place. If we want to know whether the statement 'the sun is shining' is true or false, we only have to look and see. But life is not always so simple. Sometimes we need to deduce or prove the truth from one or more known premises, and while this may not be a difficult task for an intelligent person, it can be a highly complex one for a computer program. Consider a court of law, for example, where the objective is to ascertain the truth from the evidence. The judge and jury may deliberate for days or even weeks in their attempts to decide the truth, so can we really expect that a computer program might one day be able to do their work and provide a verdict a few seconds after digesting the premises?

Proof is an area that has always fascinated a significant proportion of the AI fraternity, and in some areas of mathematics, notably geometry and logic, computer programs have shown themselves to be rather adept at theorem proving. One of the earliest examples was the 'Geometry Theorem Machine', first described by Gerlerntner in 1959, which could prove theorems considered quite difficult by an average secondary school pupil. Quite recently we have seen a computer proof of the famous 'Four Colour Problem' (prove that using only four colours, it is possible to colour any map so that no two adjacent countries have the same colour).

The Geometry Theorem Machine

This was not a machine but a program running on an IBM 704 computer. In the early spring of 1959 it proved its first theorem in elementary Euclidean geometry, and subsequently it discovered proofs to numerous problems found in school text books. Its 'knowledge' consisted of a number of rules or theorems on such subjects as parallel lines, the congruence of triangles, and the equality and inequality of segments and angles, and it employed heuristic methods to guide it towards proof sequences that had a high probability of leading to a proof of the original theorem.

The reason why heuristic methods are needed in theorem proving can be seen from a comparison between the proof process and the search of a game tree. Starting from the root of the tree (that is, the situation in which certain premises are given), the program could apply each of its known rules or axioms (which correspond to the legal moves in a game tree) to this root situation, thereby creating new situations (that is, new nodes on the tree). This process could then be repeated, so that at each stage of the search process every possible axiom would be applied to every existing unexamined node in the tree. Eventually a proof would be found (provided that one exists), because eventually the program would have generated a tree so big that it contained one path (that is, one variation) which converted the root situation into a proof.

The problem with the above approach is similar to the problem of trying to make the perfect move in a chess game by examining every legal move to a great depth. The tree gets too big too soon and the program's available thinking time is rapidly exhausted. An heuristic approach to theorem proving drastically limits the size of the tree, by selecting only those axioms which appear most likely to lead to a successful proof. (In fact, Gerlerntner's program employed a graph as its data structure rather than a tree. I have used the tree as a simplification because readers of this series will already be familiar with tree-related concepts).

The Geometry Theorem Machine worked backwards from the desired theorem, so that every sequence it considered was known to end with a proof of the desired theorem. Most of these sequences will be false, but by using heuristic methods to recognise their falsity, these sequences could be immediately rejected, allowing the pruning of the irrelevant parts of the proof tree. Consider the flow diagram shown in Fig 1 which explains how the heuristic methods were applied.

- **1 Scan diagram** With every theorem that needs to be proved, there is a diagram which is scanned by the program so that three lists can be constructed — one containing every segment in the diagram, one containing every angle and one containing every triangle. Each item on a list is attached to a sublist which describes that item.
- **2 Set up initial conditions** The premises are placed on a list of established formulae, and the conclusion is put on the tree as a subgoal. If this subgoal is achieved, then the program has proved the theorem.
- **3 Expand definitions** Certain definitions are added to the list of established formulae.
- **4 Choose generating subgoal** The program selects a subgoal which it wants to establish. Selecting a subgoal is analagous to a game-playing program selecting which position on the game tree should next be expanded.
- **5 Generate lower subgoals** Appropriate axioms and theorems are chosen from the list of premises and, by working backwards, a set of lower subgoals is established such that if any one of these subgoals is achieved, then the parent subgoal is established. If the parent subgoal has been labelled 'provisionally fruitful', the program tries various geometrical constructions.
- **6 Discard unwanted lower subgoals** The program rejects any of the newly created subgoals which are seen


A I

from the diagram to be obviously not valid. If it finds any newly created subgoals which are the same as or equivalent to any subgoals already on the tree, it rejects those deepest in the tree as being achieved with more steps than necessary.

• **7 Is the generating (parent) subgoal established?** If any newly created subgoal is established by virtue of the fact that it is on the list of established formulae (or if it can be assumed from the diagram) then the parent subgoal is established, otherwise:

• **8 Add acceptable lower subgoals (if any exist) to the tree** The program adds acceptable non-redundant lower subgoals to the tree and chooses a new subgoal from which further subgoals may be generated. If there are no acceptable lower subgoals and a geometric construction is possible in the diagram, then the parent subgoal is marked as 'provisionally fruitless'. If a construction is not possible or if the program has tried and failed to find one, the parent subgoal is marked 'fruitless'.

• **9 Are there any parallel subgoals to be established?** If the parent subgoal is established it is added to the list of established formulae, together with all of the higher subgoals on the tree which are established as a direct result. If there are no parallel subgoals (sibling subgoals are said to be 'parallel' if it is necessary to establish *all of them* in order to establish the parent subgoal) remaining to be established, the program realises that it has found a proof of the theorem and prints it out.

• **10 Failure** If at any time the program discovers that every unexamined subgoal on the tree is fruitless, the program admits that it has failed to find a proof of the theorem.

Most of the intelligence in Gerlernter's program resided in blocks 4, 5 and 6 of the flow diagram, where subgoals are chosen, generated and discarded. He discovered that a linear increase in the number of points in the original diagram would lead to an exponential increase in the complexity of the proof process, and it was, therefore, essential to employ powerful heuristics.

Clearly it is desirable to be able to select those subgoals that have the greatest chance of leading to a proof, just as in a game tree it is desirable to select those moves which have the greatest chance of being correct. Two specific heuristics were used to achieve this aim. The first would recognise subgoals that could usually be established in one step, such as geometric identities. The second was a scoring function, analagous to those used in game-playing and problem-solving programs, which assigned a score to each subgoal according to how close or far it appeared to be from the premises. Adding these two heuristics not only speeded up the proving process, it also resulted in the program finding shorter (that is, more elegant) proofs.

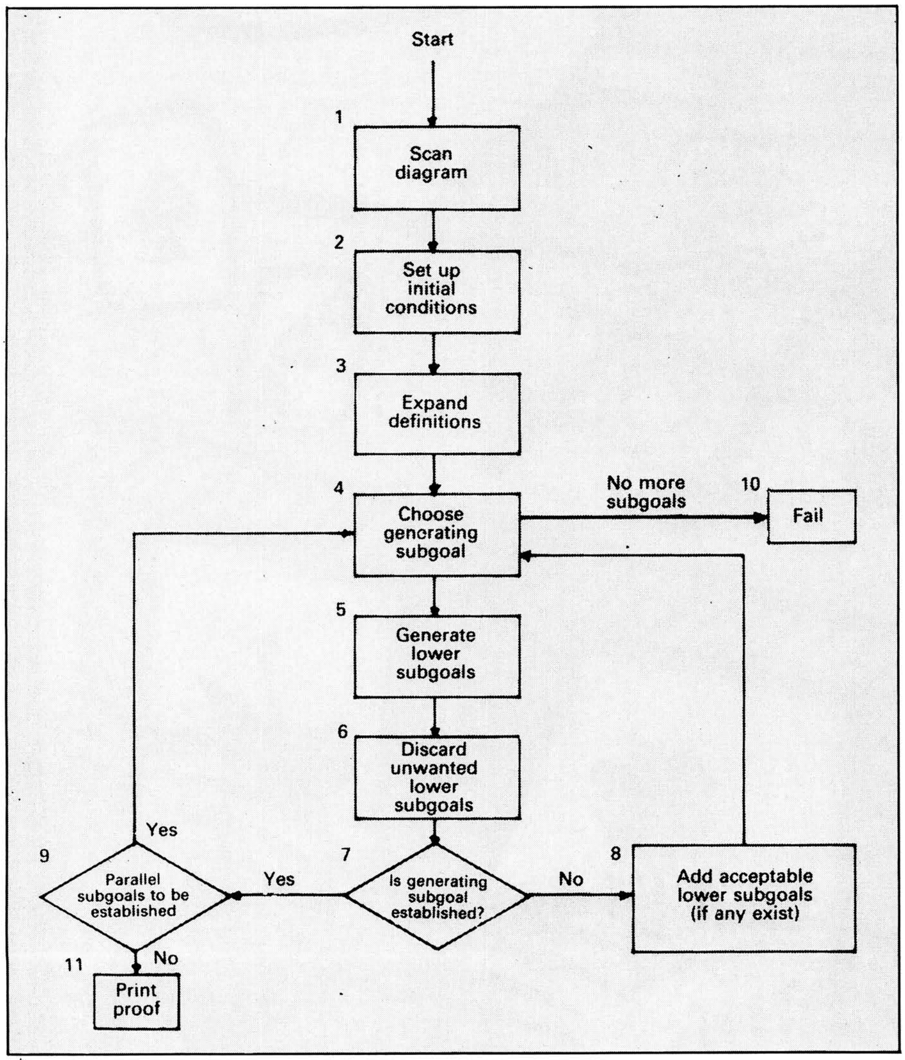

Fig 1 Flow diagram of the Geometry Theorem Machine

Proving theorems in logic

The Geometry Theorem Machine is an excellent example of simple proof techniques being used in a specialised environment, that of Euclidean geometry. To be of more general use, a proving program must be able to cope with a wide range of problem environments, and for this reason much of the work on computerised proof has concentrated on mathematical logic. (The laws of logic are sufficiently general that they may be fitted to any problem-solving domain).

In the mid 1950s Newell, Shaw and Simon devised a program called the Logic Theory Machine, whose task was to prove theorems in elementary symbolic logic. This system of logic is founded on expressions built from combinations of basic symbols. Five of these expressions are taken as axioms, and there are rules by which new theorems may be inferred from the axioms and from other theorems. The system of axioms, definitions and rules employed in the Logic Theory Machine was exactly that used in *Principia Mathematica* by Whitehead and Russell, one of the outstanding 20th century books on mathematics. These are:

if (p is true *or* p is true) *then* p is true
if p is true *then* (q is true *or* p is true)
if (p is true *or* q is true) *then* (q is true *or* p is true)
if [p is true *or* (q is true *or* r is true)] *then* [q is true *or* (p is true *or* r is true)]
if (*if* p is true *then* q is true) *then* [*if* (r is true *or* p is true) *then* (r is true *or* q is true)]

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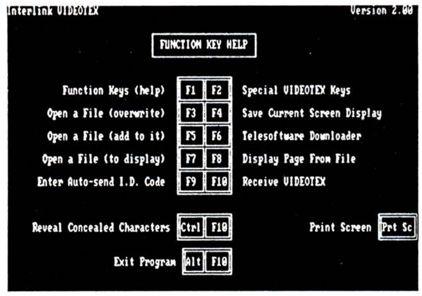

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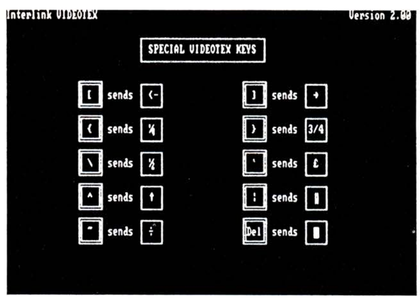

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The Logic Theory Machine was given a number of true theorems, and three rules that could be used to infer new theorems:

(a) The rule of 'substitution':

Any expression may be substituted for any variable in any theorem, provided that the substitution is made throughout the theorem wherever that variable appears. For example, in the second axiom, if we replace the variable 'p is true' by the expression 'p is true *or* q is true', we get the new theorem:

if (p is true *or* q is true) *then*
(q is true or {p is true or q is true})

(b) The rule of 'replacement':

Words such as 'or' and 'implies' may be replaced by their definitions, and vice versa.

By definition, '*if* p is true *then* q is true' is equivalent to '*if* not-p is true *or* q is true', so that if 'p' means 'this is a ball' and 'q' means 'this is round' we can see that the theorem:

'*if* this is a ball *then* this is round'
is equivalent to
'this is not a ball *or* this is round'

because if the expression 'this is not a ball' is false, then clearly this is a ball, and therefore it is round.

As an example of replacement we can replace '*if* p is true *then*' by '*if* not-p is true *or*' in the second axiom, and we get the new theorem:

if p is true *then* (q is true *or* p is true)

(c) The rule of 'detachment':

If 'A is true' is a theorem (that is, it is true), and if '*if* A is true *then* B is true' is a theorem (that is, it is also true), then 'b is true' is also a theorem (that is, it too is true).

For example, if the following is a theorem:

*if**[*if* (p is true *or* p is true) *then* p is true]* *then* (*if* p is true *then* p is true)

then since the expression between the two asterisks is known to be true (it is the first axiom) we have the new theorem:

if p is true *then* p is true

The Logic Theory Machine at work

In essence the method is similar to the tree expansion method described for the Geometry Theorem Machine. A crude way to prove a theorem is what Newell, Shaw and Simon called the 'British Museum Algorithm'. Make the theorem the root of a tree and then apply all the possible substitutions, replacements and detachments, each of which would create a new node on the tree. Each of these nodes could then have applied to all the possible substitutions, replacements and detachments, and so on. Eventually, if the program did not run out of time or memory, it would create a node which corresponded to one of its known theorems, and it would then produce a proof of the original theorem by traversing, in reverse order, the steps from the newly created node (corresponding to an existing theorem) back up to the root of the tree.

Obviously this brute force approach will exhaust the available computation time and computer memory for all but the very simplest of theorems. Using this method, and being allowed three iterations (which created proofs for 42 new theorems), the Logic Theory Machine was only able to solve one of the 60 or more theorems in Chapter 2 of *Principia Mathematica.* Three more proofs were achieved after two further iterations (that is, within the first 115 new theorems), one more within the next two iterations (that is, the first 246 new theorems), and one more within the first 1000 new theorems. In order to avoid creating useless theorems, the program therefore needs some heuristics to enable it to select which substitutions, replacements and detachments should be applied, and other heuristics to determine the nodes on the tree to which they should be applied.

A powerful heuristic employed by the program is called 'chaining'. If the program encounters a theorem of the form:

if A is true *then* B is true

which it needs to prove, it searches for an axiom or theorem of the form:

if A is true *then* Z is true

and if it finds one, it knows that it can prove the previous theorem by proving the theorem:

if Z is true *then* B is true

When a new problem is presented to the Logic Theory Machine, it first tries substitution, using all the axioms and theorems that it has been told to assume and which are already stored in its

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theorem list. If substitution fails, the program tries detachment, and as each new subproblem is created by a successful detachment, an attempt is made to prove the new subproblem by the substitution method. If substitution still does not work, the subproblem is added to a subproblem list.

If detachment fails for all the theorems in the theorem list, the same cycle is repeated with chaining — try to create a subproblem; try to prove it by substitution; if unsuccessful, put the new subproblem on the list. If substitution ever succeeds with a single subproblem, the original theorem is proved.

If these methods have been tried on the original problem and no proof has been found, the next untried subproblem is taken from the subproblem list and the same methods are applied to this subproblem. This process continues until a proof is found, or until no more subproblems remain on the list, or until time or memory is exhausted.

In order to determine which theorems on the list should be tried for substitution, replacement and detachment, the program employs a type of evaluation function called the 'similarity test'. Two logic expressions are said to be similar if both their left-hand sides look alike and both their right-hand sides look alike. (There is a more rigorous definition of similarity employed in the program). For example:

if p is true *then** (q is true *or* p is true)

and

if r is true *then** (*if* m is true *then* r is true)

are similar, because the expressions between each pair of asterisks are of exactly the same form, and the expressions to the right of each right-hand asterisk are similar because (*if* m is true *then* r is true) is similar to (not-q is true *or* r is true), as we have seen in the example of replacement given above. The similarity test reduces substantially the number of substitutions, replacements and detachments attempted at each node, in some cases by a factor of 10.

Although the Logic Theory Machine was one of the forerunners in the field of automatic theorem proving, it was able to prove 38 out of the 52 theorems in Chapter 2 of *Principia Mathematica.* During the three decades that followed this pioneering work of Newell, Shaw and Simon, theorem proving has become one of the most prominent areas of AI research. There is now a plan at McGill University, Montreal, to hold the first 'World Theorem Proving Championship', in which programs will be awarded points for successfully proving a number of test theorems in elementary logic. This idea was conceived by Professor Monty Newborn, who was one of the organisers of the very first computer chess tournament (held in New York in 1970), and if the world of computer chess is anything to go by, such an event might provide the stimulus for the creation of programs that can perform at the level of a mathematics PhD.

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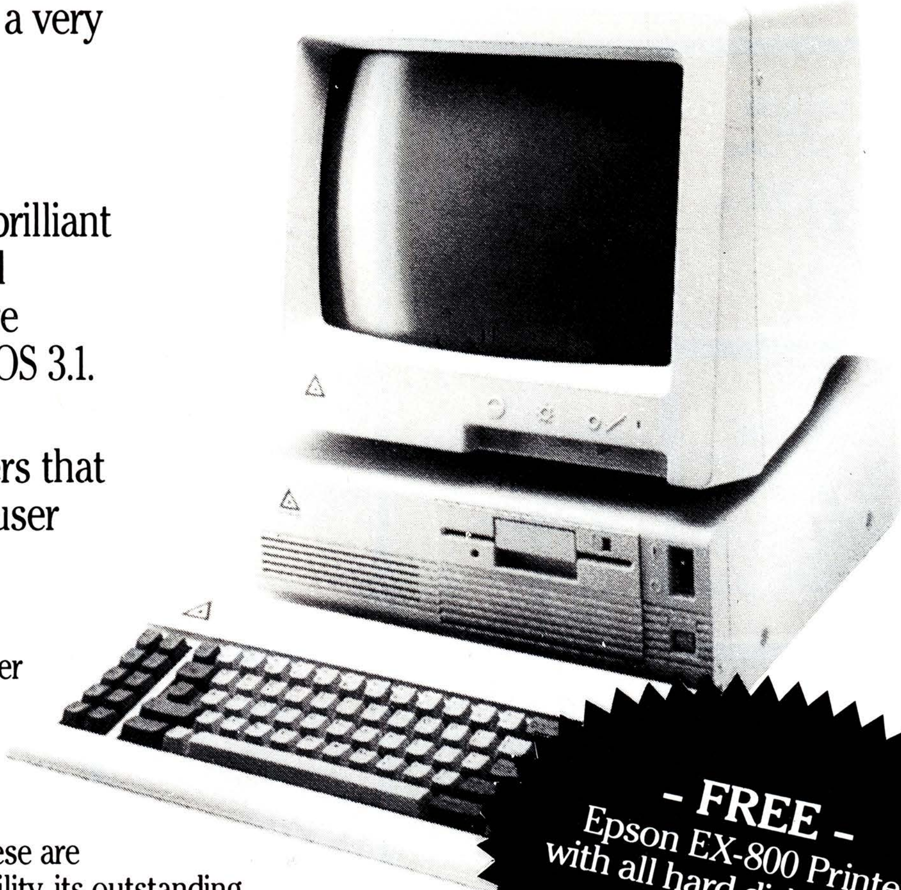

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Smalltalk V

Smalltalk is a programming language which, after various incarnations, has manifested itself as Smalltalk/V, a versatile tool for the development of a wide range of applications. Carl Phillips engages it in conversation.

At the beginning of the 1970s, Xerox Corporation created its famous Palo Alto Research Centre (PARC). PARC's Learning Research Group, under the leadership of Alan Kay, embarked on a 10-year research project concerned with the Dynabook — a notebook-sized computer which anyone could use, and which was so convenient that you could use it to store and manipulate your grocery list (a test still failed by the personal computers of today).

To accompany the Dynabook, the Learning Research Group began to design a new programming language. The Learning Research Group credits the simulation language Simula (a Norwegian derivation of Algol 60), Sketchpad (the first interactive graphics program) and Lisp as the major influences on its design.

History

The Dynabook programming language was named Smalltalk after the conversation at parties and as a reaction to the grandiose names of other research projects. This research led to the development of a series of Smalltalk languages, each inspired by its predecessor, culminating in 1980 in the language Smalltalk-80 (trademark Xerox). The Learning Research Group documented the Smalltalk research in the August 1981 issue of *Byte*, in a series of technical papers, and in three books published by Addison-Wesley.

The Smalltalk research has prompted many of the recent developments in personal computing. Xerox's ill-fated Star, Apple's Macintosh, and windowing environments such as Microsoft's Windows or Digital Research's GEM, are all directly descended from the Xerox research. Mention Smalltalk, and most computer users say: 'Oh, yes! Windows and mice . . . inspired the Macintosh.'

Although important, windows and mice are only one part of the Smalltalk research. The Learning Research Group consistently applied a small number of innovative ideas in the design of a powerful integrated programming environment. Everything you would traditionally use in developing a program — programming language and compiler, text editor, operating system and utilities, linker, debuggers, profilers, source code change management facilities, and application programs — are all built into a single, unified whole.

Smalltalk was designed to run on 'Interim Dynabooks' — powerful experimental Xerox personal computers. These systems, built in the 1970s, were based around the high-speed logic families used in minis and mainframes. Unlike microprocessor-based systems, the CPU instruction set was microcoded, and could be redefined by a programmer to gain speed and optimise performance for particular applications. Even today, personal computers are only just reaching the raw performance levels of these early PARC systems. The original Smalltalk implementations made extensive use of microcode to gain adequate performance, and even taxed the resources of these powerful PARC computers.

The Dynabook was envisaged as using some kind of liquid crystal display that would mimic a full page of paper, so the PARC computers were equipped with a high-resolution, A4, bit-mapped graphics display and a little-known pointing device — the mouse.

The Learning Research Group held a number of heretical beliefs about the nature of programming and computing; among the most important was the belief that it was OK to spend large amounts of computer time and resources on improving the ease with which people could program and use computer systems. The Smalltalk research largely ignored issues of machine efficiency, long before this became fashionable.

By 1980, the name Smalltalk was somewhat misleading. Smalltalk-80 is a big, powerful system that combines many of the best ideas in computer science in a highly usable and productive environment. When Xerox began demonstrating and publishing information about its research, many people outside Xerox became interested in learning more about Smalltalk.

Until recently, getting your hands on a working Smalltalk system was difficult and expensive. From Xerox's point of view, Smalltalk was a research project and there was no undertaking to make it available as a commercial product. The very nature of Smalltalk as a research project requiring powerful, expensive and esoteric hardware, made it difficult to see what form a commercial product derived from the research would take. The unavailability of a usable implementation, plus Smalltalk's unusual syntax and terminology, put many programmers off learning any more about the language.

Xerox has licensed the Smalltalk-80 image to a large number of academic institutions, but there are currently only three commercial suppliers of the Xerox

Smalltalk-80 image. Tektronix has a series of high-performance, 680X0-based AI workstations designed expressly for Smalltalk-80; the starting price is around $28,000. Softsmarts Inc, a small firm in California, has Smalltalk-80 available for the IBM PC/AT for $US995. It requires an AT with 1.5-2Mbytes of memory, a hard disk, plus an Enhanced Graphics Adaptor. Apple Computer has a pre-release, experimental, unsupported version of Smalltalk-80 available for the Macintosh for $US50 (many of the original PARC researchers, including Alan Kay, now work for Apple). In August this year, Xerox announced a spin-off company named Parcplace Systems, which will be commercially marketing Smalltalk-80 on behalf of Xerox.

In December 1984, a small Los Angeles-based company named Digitalk introduced its own version of Smalltalk, named Methods, for the ubiquitous IBM PC and compatibles. For a mere $US249, potential Smalltalk programmers could see what all the fuss was about. Method's syntax was compatible with Smalltalk-80, but the language itself was a subset and ran in a character-based environment that was greatly inferior to that of Smalltalk-80. Now Digitalk has introduced Smalltalk/V, which is Method's version but with bit-mapped graphics, numerous improvements and extensions, and a price reduction — Smalltalk/V costs $US99.

This is a complete Smalltalk; not a cut-down or toy version of the language, but a thoroughly professional product capable of serious work. There are some limitations and restrictions compared to Xerox Smalltalk-80, but in compensation, Smalltalk/V is much better orientated towards use on MS-DOS-based personal computers and is considerably faster. On an IBM AT, it out-Benchmarks Smalltalk-80.

Smalltalk/V runs on an IBM PC, XT, AT or compatible with a minimum of 512k of memory, a Microsoft or compatible mouse, a graphics adaptor (as a minimum, the IBM colour graphics adaptor, but the Enhanced Graphics Adaptor or a Hercules card gives better results), twin disk drives (but a hard disk is much better), and an 8087/80287 co-processor if you plan on using floating point arithmetic.

Although performance is just about tolerable on a standard PC, it's much more satisfactory on an AT, a PC with a turbo card, or a fast clone. If you have an Enhanced Graphics Adaptor, Smalltalk/V supports the 640x350 high-resolution mode, giving some sorely-needed additional screen space. (If you are using a mouse with the EGA, check the mouse driver. It must support the new EGA screen modes).

Smalltalk is adept at handling 'sloppy problems' — many interesting problems in personal computing fall into this category. Almost any program that has to communicate with human beings has to go through numerous revisions before the user interface 'feels right'. Problems that are not clearly understood, problems with no clear solution or a variety of possible solutions, are also good candidates.

Smalltalk supports exploratory programming. Working within the integrated environment, you can build and test programs piece by piece. Long before the entire program is working, you can experiment, evaluate alternative approaches, and exercise your code.

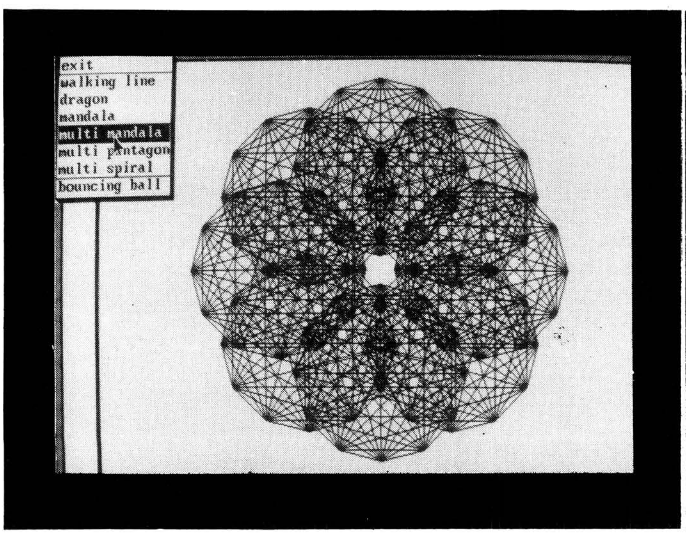
Making changes is fast and easy. Best of all, programming in Smalltalk is great fun.

The language

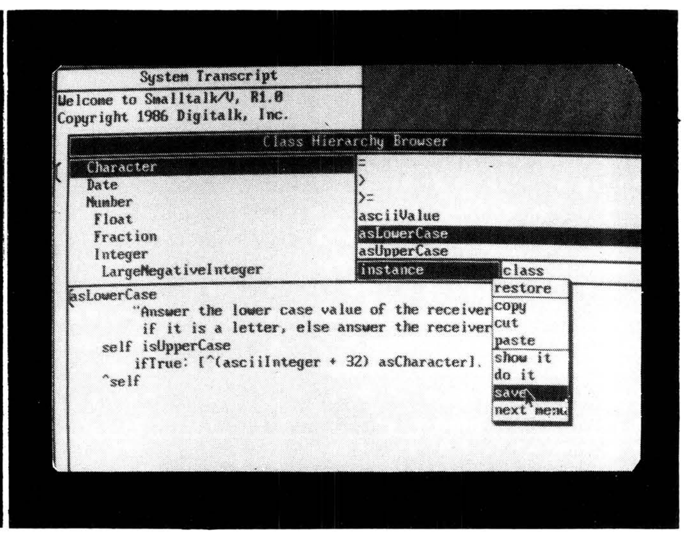
Smalltalk is a uniformly object-orientated language. Every component of the system is represented as an object. A Smalltalk program is a collection of *objects* that communicate by sending and receiving *messages*. Each object can store some data and has a set of *methods* (equivalent to the procedures, subroutines or functions of conventional languages) which define the messages it can understand. Similar objects are grouped into *classes*. All the objects belonging to a particular class share the same structure and set of methods. The Smalltalk classes are organised into a tree structure. At the root of the tree is class 'Object', which defines the default structure and behaviour of all objects. All the other classes are *subclasses* of Object. A subclass *inherits* its structure and the methods it understands from the parent or *superclass*, but can alter the structure, and add, delete or change the set of methods an object (called an *instance*) of its class will understand. Fig 1 illustrates the Smalltalk/V class hierarchy (subclasses are indented).

As Fig 1 shows, everything in Smalltalk is represented as an object, from the low-level components such as integers, floating-point numbers, dates, times, strings or arrays, through to high-level components such as text editors, window panes, compilers or applications programs. Even the internal state of an executing method (roughly equivalent to the stack activation record of languages such as C or Pascal) is represented as an object called a *context*.

Like Forth, Smalltalk is an interactive,



Logo-style turtle graphics are supported, and simple, animated images can be manipulated



Smalltalk differs from the Mac in that the menus pop up at the cursor position, rather than from a menu bar

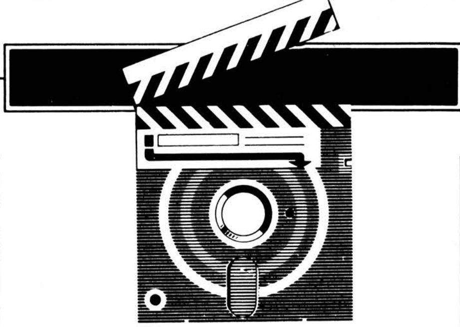
extensible language: almost all of Smalltalk is written in Smalltalk. At the centre of the system is a set of primitive methods, implemented in assembly language. Smalltalk/V comes with around 120 classes and 2000 methods. The entire Smalltalk source code for all classes (except the compiler class and primitive methods) is supplied. The source code is online and available at all times in the programming environment.

Programming in Smalltalk consists of defining and redefining classes and subclasses, and specifying their structure and behaviour. A tremendous amount of functionality is already built into the system.

Objects can be visualised as specialist, little, abstract computers. Objects, like computers, are a package that have some structure — private data (or memory), plus they understand how to perform a set of operations upon the data. To ask an object to perform a particular operation, you send it a message requesting it to carry out that operation. ('Message' has become overloaded in computing — Smalltalk messages have nothing to do with networks or concurrency). An object's memory or data is private and cannot be accessed from outside. It can only be accessed by sending a message to the object, which invokes a method that acts upon that data. The only way an executing method can gain access to other objects is to send messages to them as part of its actions. Program flow can be viewed as a conversation between communicating computers.

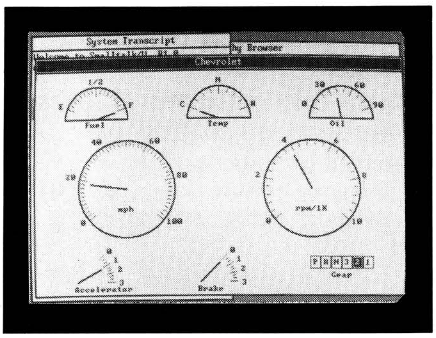
Note that sending a message to an object specifies what should be done, but not *how* it should be done. The methods in an object are free to choose how to respond to the message. An object is a black box; all a programmer needs to know about is the set of messages it responds to and the actions they perform — its *message interface*. If objects of different classes respond to the same messages, the code in a method will work OK with these different classes. As a consequence of this type of independence, it's easy to write code that handles a variety of different data types, and will continue to work even with new classes defined long after the original code has been written.

Object orientation provides a higher-level structuring mechanism than the operator/operand model of conventional programaming languages such as C, Pascal or Modula-2. The closest analogy is probably with the implementation of abstract data types in languages such as Modula, Ada or an extended Pascal, but there are important differences.



Smalltalk uses 'run-time' or 'late' binding. In early bound languages such as Pascal, if you call a print procedure with a floating-point number, the compiler checks that the print procedure expects a floating-point number and complains if it's of a different type.

In Smalltalk, sending a message is a polymorphic (independent of type) procedure or function call. Ask an object to print itself, and it looks for the print



Demonstration programs include a Chevrolet dashboard simulation

method among its methods. If it can't find the print method, it looks in its superclass methods and if it isn't found there, backs right up the tree, ultimately to class Object looking for a print method. If it can't find out how to print, an 'Object does not understand: messageName' error results. (Apart from division by 0 and I/O errors, this is one of the few run-time errors that occurs in Smalltalk programs). The crucial difference is that the decision as to which procedure or function is called is made at run-time in Smalltalk, and at compile time in Pascal or C.

Object orientation divides programs up into highly modular systems. Provided the message interface remains the same, you can make any changes to an object that you like — secure in the knowledge that you can't do any damage. Large programs are built upon the same principles as small programs, and you can make changes to very complex programs without having to comprehend how everything works.

The programming environment

Programming in the Smalltalk environment is quite different to conventional programming of a personal computer. Load-up Smalltalk/V, and the humble PC is transformed into a system resembling a Sun or Symbolics workstation.

The Smalltalk environment is stored on disk in the form of a snapshot of a running system. This image reflects the system exactly as it was saved. When you come to exit Smalltalk at the end of a programming session, you have the option of saving the image to disk. Restarting Smalltalk loads the image back exactly as it was when you quit. If required, multiple images can be maintained in different subdirectories on disk.

While there are detail differences, the screen appearance will be familiar to anyone who has used an Apple Macintosh. Multiple overlapping windows appear on the display. Text can be cut and pasted between the different windows by highlighting it with a mouse and selecting 'cut' or 'paste' from the menu. (Smalltalk differs from the Macintosh in that menus pop up at the current cursor position rather than pull down from a menu bar at the top of the screen). Unlike Smalltalk-80, which really requires a three-button mouse, Smalltalk/V uses the two-button Microsoft mouse or a compatible.

The Smalltalk environment is probably closest to that of Lisp, Logo or Forth. Smalltalk is incrementally compiled into bytecodes for a virtual machine (in a similar manner to the UCSD Pascal system). Enter some Smalltalk code in a window, highlight it with the mouse, select 'Do It' from the pop-up menu and the code is compiled and executed. If there are problems in compiling the text, an explanatory message is inserted at the location of the problem. If everything has compiled OK but there's a run-time error, a walk-back window pops up in the middle of the screen, showing a backtrace of message sends. A separate debugger window, or a special window called an 'inspector', can be used to examine the state of the halted program.

Defining or redefining classes and subclasses is normally done using a browser window. A class browser displays one class in a multi-paned window and lets you change the structure, or add, delete or change a method. When your changes are complete, selecting 'Save' from the pop-up menu recompiles the class or method(s). A variant of the class browser, the class hierarchy browser, shows you the big picture with a list of classes in the first pane, method names in the second, and the actual source of methods at the bottom. All the changes you make are stored in a disk file called

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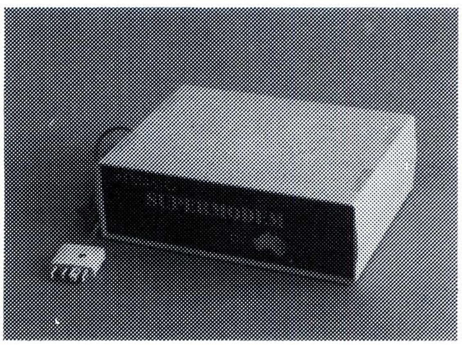

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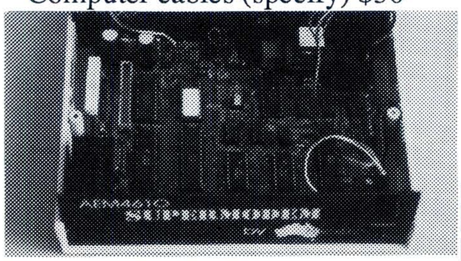

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the 'change log', which stores updated and new source code. If your changes crash the system, most of your work can be recovered without loss by reading-in the change log.

Extending the system

As all work is carried out in the one environment, it's easy to extend and build new tools to aid your programming. There's no distinction between system code and applications code. Both the source code and the compiled form of programs are accessible as objects, as is the representation of program state and that of the system itself.

The end result is that Smalltalk is tremendously malleable and flexible: it's easy to customise the system to suit your tastes and applications. Expanding the language or environment is easy. The general philosophy is expressed succintly as: 'If you don't like it, you can change it.'

Smalltalk/V comes with bit and form editors which let you create and edit bit-map pictures in a similar way to the Apple MacPaint program on the Macintosh ('form' is Smalltalkese for bit-map). Logo-style turtle graphics are supported with a Pen class, and simple, animated images can be manipulated using a subclass of Pen named Animation.

Smalltalk/V's disk browser window provides much of the functionality of the DOS command interpreter COMMAND.-COM in a visual manner. In a similar manner to the class hierarchy browser, you can browse the DOS directory tree structure, select and edit files, delete, rename or print files, file-in and compile Smalltalk source code, and so on.

Demonstration programs supplied include some simple graphics demonstrations, a graphical Chevrolet dashboard simulation, and an extension to the disk browser that draws a graphical tree of the DOS directory structure, allowing you to scroll around with the mouse. Smalltalk/V comes with an embedded implementation of Prolog that lets you mix rule-based declarative programming with Smalltalk-style, object-orientated programming. As with everything else, the source to Prolog/V and the demonstration programs is supplied on disk.

Smalltalk/V lets you define your own primitive methods in assembly language via the MS-DOS terminate-and-stay-resident facility. With a little work, you can call C or Pascal functions. Using a simple word-swap capability, you can exit to DOS and execute DOS programs from within Smalltalk.

If you come up against the dreaded 640k memory limit of current PCs, Smalltalk/V supports a simple form of virtual memory management. When an allocation request fails, objects are automatically swapped out to disk. Window images are normally cached in a form to allow fast screen redraw, but a toggle lets you trade space for speed if you're running large applications, redrawing the image when necessary.

Smalltalk/V's documentation consists of a 500-page manual, perfect-bound, in the format pioneered by Borland with Turbo Pascal. It is divided up into three

```
Object
  Behaviour
    Class
    MetaClass
  BitBlt
    CharacterScanner
    Pen
      Animation
      Commander
      FreeDrawing
  BitEditor
  Boolean
    False
    True
  ClassBrowser
  ClassHierarchyBrowser
  ClassReader
  Collection
    Bag
    IndexedCollection
      FixedSizeCollection
        Array
        Bit-map
        ByteArray
          CompiledMethod
          FileControlBlock
        Interval
        String
          Symbol
      OrderedCollection
        Process
        SortedCollection
    Set
      Dictionary
        IdentityDictionary
          MethodDictionary
        SystemDictionary
      SymbolSet
  Compiler
    LCompiler
  Context
  ControlApparatus
    Scale
      Dial
    Switch
      Button
  ControlPanel
    Dashboard
  CursorManager
    NoMouseCursor
  DemoClass
  Directory
  DiskBrowser
  Despatcher
    GraphDespatcher
    PointDespatcher
    ScreenDespatcher
    ScrollDespatcher
      FormEditor
      ListSelector
      TextEditor
        PromptEditor
    TopDespatcher
  DespatchManager
  DisplayObject
    DisplayMedium
      Form
        DisplayScreen
        SelectorForm
  File
  Font
  Inspector
    Debugger
    DictionaryInspector
  Magnitude
    Association
    Character
    Date
    Number
      Float
      Fraction
      Integer
        LargeNegativeInteger
        LargePositiveInteger
        SmallInteger
    Time
  Menu
  Message
  Pane
    SubPane
      GraphPane
        FreeDrawPane
      ListPane
      TextPane
    TopPane
  Pattern
    WildPattern
  Point
  Prompter
  Rectangle
  Stream
    ReadStream
    WriteStream
      PrinterStream
      ReadWriteStream
        FileStream
        TerminalStream
  StringModel
  TextSelection
  UndefinedObject
  SwappedOutObject
```

Fig 1 Smalltalk/V class hierarchy

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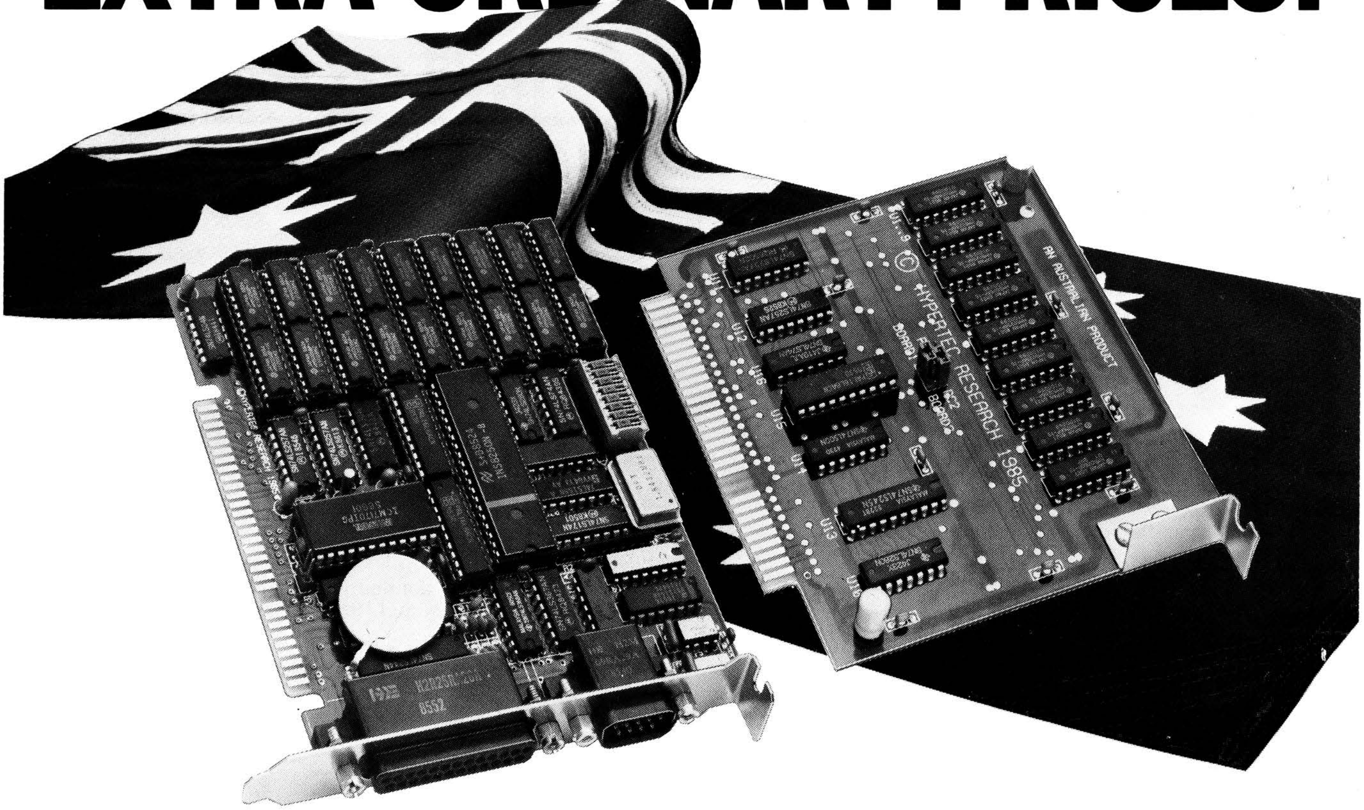

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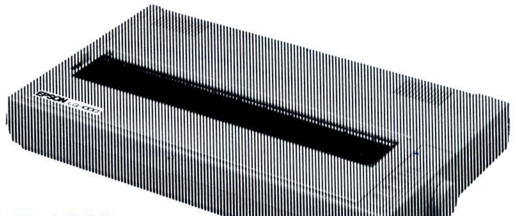

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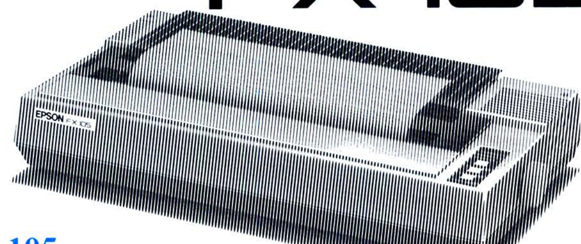

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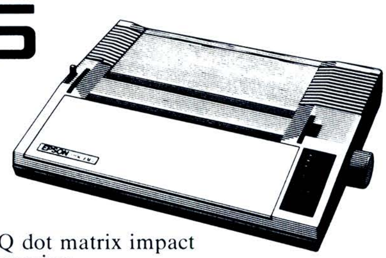

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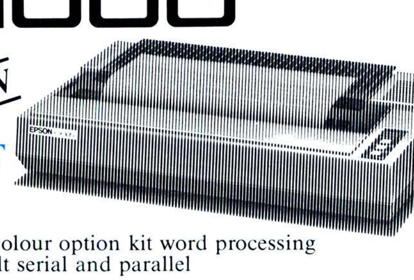

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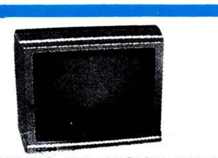

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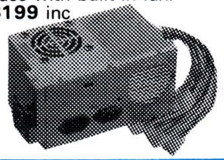

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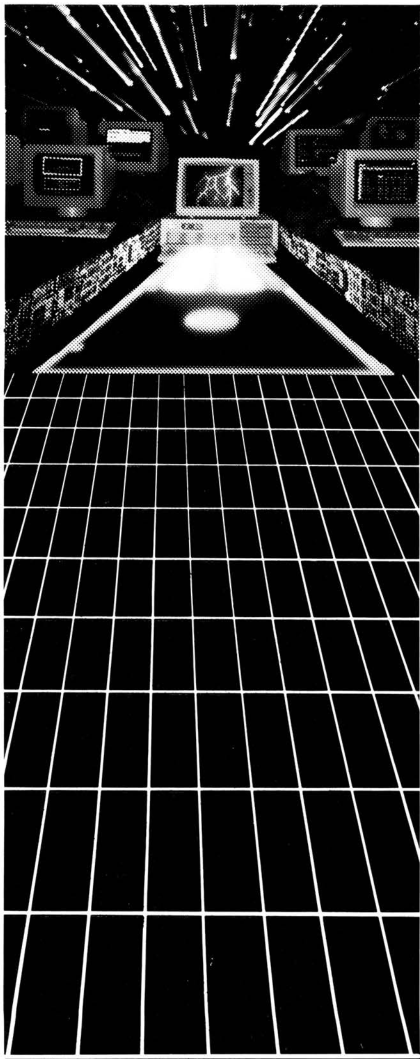
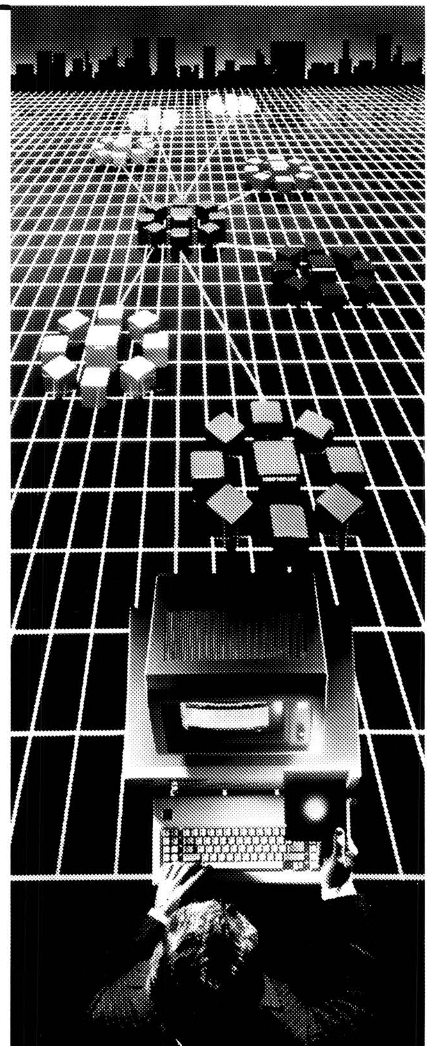
sections: the first 10 chapters are a tutorial introduction to Smalltalk/V; chapters 12 to 14 form a reference guide; and the remainder of the manual documents the class library. The tutorial is very well done. Full source code for each of the tutorial examples is provided on disk, eliminating the monotonous task of typing them in. There is both a conventional (and comprehensive) index, and a method index which shows which classes implement a particular method.

Conclusion

Smalltalk/V is a remarkable product. If you are interested in object-orientated programming, programming language design, developing high-quality applications programs, integrated environments, or simply what programming and using a personal computer should be like, it is highly recommended. At $US99 (about $Aust157) it's excellent value for money.

Smalltalk/V comes on three floppy disks. It isn't copy-protected. It's available from Digitalk Inc, 5200 West Century Boulevard, Suite 250, Los Angeles, California 90045, tel: (0011 1) 213 645 1082, for $US99.95 plus $US15 airmail carriage. END





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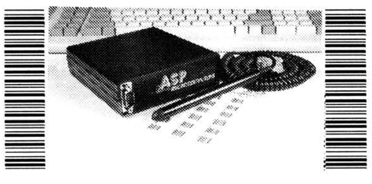

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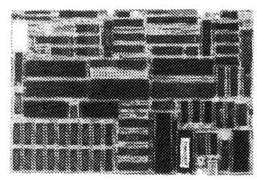

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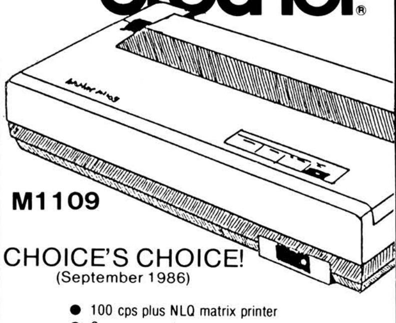

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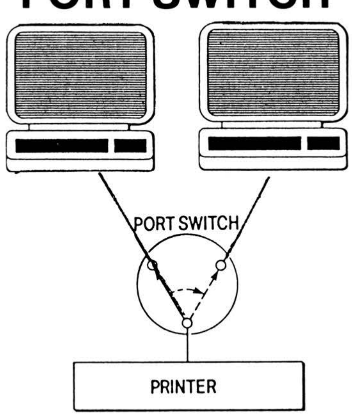

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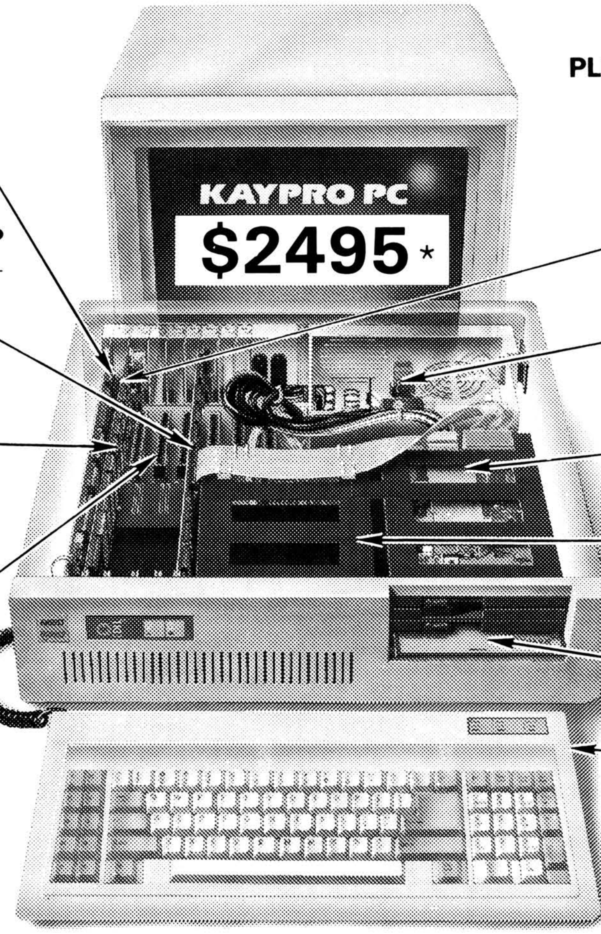

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MS-DOS programming

This new series by Ian Davies looks at the MS-DOS operating system from the inside out, and shows how to work 'magic' using MS-DOS internals. A practical example is included at the end of this instalment.

Mainframes have always had systems programmers, yet the term has never really been applied to the PC world. Perhaps the word 'hacker' has always been used in its place. It's a mystery, as the PC environment allows far more to be done by an adventurous programmer than most mainframes.

This new series will be looking closely at MS-DOS internals, and will show how to write your own MS-DOS drivers, handlers and supervisors. Each month, we will present useful programs which illustrate the various techniques discussed.

Why would anyone want to be able to do all this?

Very simply, if you are a user of other people's products, this knowledge will allow you to interface previously uninterfaceable products, make products behave differently, make them support different devices, make them behave more intelligently, make them run on other machines and generally increase your understanding of what they're doing.

On the other hand, if you're writing your own software, you can use this knowledge to increase performance, improve portability, make it run smarter, interface between languages, and generally work the sort of magic one expects to be worked in a commercially viable product.

The series is not aimed at the average end-user. Neither is it an introduction to programming in assembler. Rather, we assume that our readers are familiar with operating systems and assembly language programming, and focus these arts towards the PC environment. Many of today's PC users have either grown up with machines like the TRS-80, or have experience under VMS, MVS, VM, Unix or one of the other major mainframe or mini operating systems. Likewise, many have written assembler for other machines or other chips. For these readers, this series will aim their skills towards MS-DOS. For readers who have never before written in assembler, there are many good books available on 8088/8086 assembler, and any one of these would make good reading prior to digesting this series.

This first article in the series will cover a great deal of the basics.

The environment

Firstly, what do we class to be an MS-DOS machine?

At the one extreme, the IBM PC (and compatibles) is called an MS-DOS machine. At the other end of the range, machines like the Tandy 1000 and the NGEN running under CTOS are called MS-DOS machines as well.

The first thing to make very clear is that simply running MS-DOS is not enough to provide any degree of compatibility with other machines. MS-DOS is not a sufficently complete operating system to provide facilities for all of the things people want to do with software. For example, its support of the asynch ports is not adequate for reliable communications, its support of the screen is not adequate for most high power software, and the same is true of the printer.

There are three distinct levels involved, each of which will be dealt with in this series. They are:

- MS-DOS level
- Bios level and
- hardware level.

We will be looking at techniques which involve all three of these levels. However, if you're running one of the 'weird' MS-DOS machines, such as the Tandy 1000, HP-150 or the NGEN under CTOS, then only the MS-DOS level will work. It's useful to know this sort of stuff, particularly as a software author, as it provides insight into portability issues.

All three of the above levels are applicable to the IBM machines and true compatibles, such as the Taiwanese machines, the Tandy 2000, the HP Vectra and the trusty Olivetti M24 — in other words, anything which runs Flight Simulator and Lotus 1-2-3. Looking around the latest PC shows made it clear that just about everyone is coming out with PC compatible machines, except for producers of machines like the Amigas and the Ataris of the world, which are chasing in quite a different direction. While this means that technology has stood still, it also means a boon to the software industry. Suddenly (well, not all that suddenly), the software world has a standard hardware environment in which to work magic.

In the 8-bit CP/M days, it simply wasn't possible to write something like Flight Simulator and have it run on most of the machines in the world. Although CP/M, like MS-DOS, provided standard operating system facilities, it just didn't provide enough to really make the hardware sing and dance. I know there is a lot of press talking about 'well behaved' software, referring to software which does and does not adhere religiously to the MS-DOS level. However, with the degree of hardware standardisation taking place, there's really little need to follow the boring old MS-DOS level. Much of the successful software today

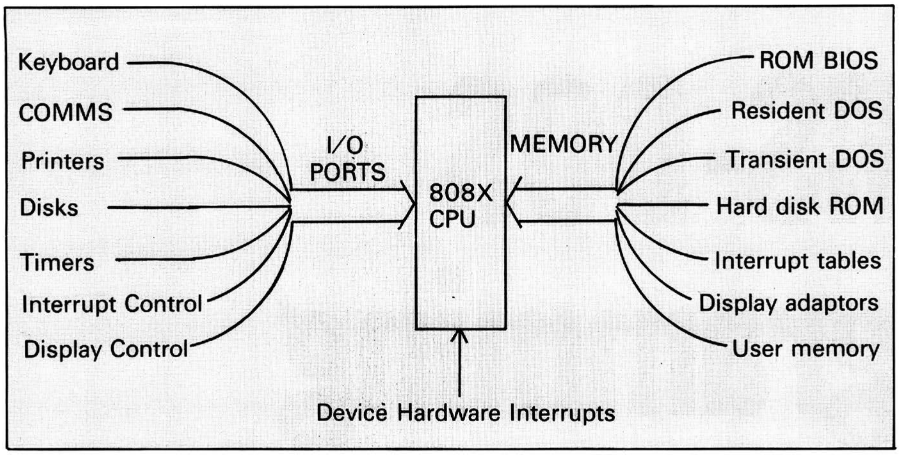

Fig 1: System architecture

Address	Function
00000 - 003FF	Interrupt Vectors
00400 - 004FF	BIOS data areas
00500 - BFFFF	Primary RAM Area
A0000 - AFFFF	Reserved
B0000 - B3FFF	Memory mapped monochrome display adapter
B4000 - B7FFF	Reserved
B8000 - BFFFF	Memory mapped colour/graphics adapter
C0000 - CFFFF	Optional hard disk ROM
D0000 - F3FFF	Reserved/Expansion Memory
F4000 - FFFFF	ROM BIOS and bootstrap loader

Fig 2: System memory map

digs into the Bios and hardware — Lotus 1-2-3, Flight Simulator, the majority of games, Crosstalk and dBase. Yet compare the screen refresh time of dBase, WordStar and Multiplan with that of Lotus. Moreover, dBase gets right down to the hardware level to implement its security, and Turbo Pascal happily provides all the necessary facilities to get at both Bios and hardware, as well as providing a special PC version which lets you do nifty things with the screen.

Let's face it, these days there is nothing really wrong with getting down to the Bios and hardware levels. MS-DOS v5 may invalidate that statement, but if it does, then it will also be going a long way towards turning PCs into minis, and that is not necessarily a good thing.

Hardware Architecture

Being an 808X based machine, the PC has two ways of connecting itself to devices. The first is through the memory address space, so called 'memory mapping' which is common on most low-end micros. This has the advantage that devices and their control registers appear as normal memory locations, and can be manipulated using the normal instructions which affect memory. As the 808X has a minimum of one million addressable memory locations, it's easy to understand why a few thousand of these can be devoted to memory mapped devices without any great loss. Figure 1 shows an overview of the system architecture.

The second method is through the I/O ports. The 808X can address up to 65,536 I/O ports, which appear to the machine in a similar way to main memory. The difference is that the I/O ports are quite distinct from memory and so, for example, memory address 200 and I/O port address 200 refer to quite different things. Physically, I/O port devices are connected up differently to memory mapped devices. Internally, special instructions must be used to access the ports and these instructions are not as versatile as the normal instructions used for manipulating memory. Whereas all high level languages are capable of accessing memory, not all are able to access the I/O ports. Basic can get at them through its OUT statement and INP function, Turbo Pascal provides the PORT array, and assembler, naturally, provides the IN and OUT instructions.

In general, all devices on the PC are accessed through I/O ports, and various de-facto standards exist specifying which I/O ports should be used for which devices. The display adaptors, however, also employ memory mapping. The controller chip for the adaptor is located in an I/O port, but the actual display buffer appears to the system as a normal chunk of memory.

Figure 2 shows a memory map of a typical PC. The exact placement of specific areas may vary slightly between compatibles depending on the size of the ROM Bios, type of hard disk, and several other factors. Note that the buffers for the display adaptors may start either at B0000 or B8000, depending on the type of display. Naturally, all software manipulates main memory, as the program itself and the data it works upon will be resident in it. Most software also manipulates the display adaptor buffers, as this is the only way to produce very rapid screen I/O. Products such as Lotus 1-2-3, Crosstalk, Multimate and almost all graphics software dive happily into screen memory, and through this, achieve their high performance and quality user interface. Messing about with the display memory introduces its own special problems, such as determining the type of display and eliminating 'snow' on colour screens. We will be examining these problems and illustrating solutions for them later in the series.

Figure 3 is a map of the I/O ports. Most software manages to get through life without directly manipulating the I/O ports. However, any high performance communications or graphics software would probably have to get involved with the ports, as there are many functions which DOS does not provide, but which can be achieved through the ports. Most

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security systems make very heavy use of the ports, and so a quite transportable product may lock itself tightly to IBM compatible hardware simply through the use of security disks. Each of the controllers shown in the I/O port map corresponds to an actual chip, usually one manufactured by Intel. For a machine to be IBM compatible, it must not only use the same I/O ports for the same functions, but must also utilise exactly the same controller chips. In this series, we will also be looking at the most useful ports, what they do, and how to use them.

Figure 4 shows the interrupt map of the PC. The first kilobyte of memory is dedicated to the interrupt vectors. This is not an attribute of DOS or the Bios, rather it is something hardwired into 808X processors. Interrupts are numbered from zero to 255 and, when a particular interrupt occurs, the 808X automatically looks up the corresponding four byte address stored in the interrupt table, saves a few registers, and branches to that location. There are actually three different types of interrupts. The first are those generated internally by the 808X; for example, divide by zero and instruction single step. The second are those generated by external devices; for example, when the status of the communications adaptor changes or a disk completes an I/O. Finally, interrupts can be generated by software. This provides the mechanism by which DOS and the Bios can be called from user programs, as it makes the user program independent of the actual address of DOS or the Bios routines. For example, interrupt number 21 (hex) is the main DOS function dispatcher.

In an ideal ('well behaved') application, the program would not interact with any of these devices. Instead, the application would call DOS, DOS would call the Bios, and the Bios would deal with the devices knowing, as it does, where they are kept, what sort they are, and how to talk to them. However, since DOS (and even the Bios) does not provide the degree of control and flexibility required for many applications, it is often necessary to control the devices directly. While this reduces the degree of portability of your software, it does deliver a higher quality result and since most machines are IBM compatible, does not affect portability too seriously.

Port Address		Function
000 - 00F	!	DMA Controller
020 - 021	!	Programmable Interrupt Controller
040 - 043	!	Timer/Counter
060 - 063	!	Programmable Peripheral Interface
064	!	Keyboard Controller
	!	
200 - 20F	!	Game control adapter
2F8 - 2FF	!	COM2: Serial comms adapter
378 - 37F	!	Printer adapter
3B0 - 3BF	!	Monochrome display controller
3D0 - 3DF	!	Colour/Graphics display controller
3F0 - 37F	!	Floppy disk controller
3F8 - 3FF	!	COM1: Serial comms adapter
	!	

Fig 3: System I/O port map

Interrupt Number		Function
0	!	Divide by Zero intercept
1	!	Single Step intercept
2	!	Non-Maskable interrupt
3	!	Breakpoint instruction vector
4	!	Overflow
5	!	Print Screen
8	!	Ticker (18.2 ticks per second)
9	!	Keyboard interrupt
E	!	Diskette interrupt
10	!	Video I/O
11	!	Configuration determination
12	!	Memory size determination
13	!	Diskette I/O
14	!	Communications I/O
16	!	Keyboard I/O
17	!	Printer I/O
19	!	Bootstrap loader
1A	!	Time of day
1B	!	Keyboard interrupt extension
1C	!	Ticker extension
	!	
20	!	DOS Program terminate
21	!	DOS Function dispatcher
22	!	DOS Terminate address
23	!	DOS Control/break address
24	!	DOS Critical error handler
25	!	DOS Absolute disk read
26	!	DOS Absolute disk write
27	!	DOS Terminate & stay resident

Fig 4: Interrupt vectors

Software Architecture

On the surface, three levels of software exist. The highest level is the application program, whether it be dBase, Lotus or your latest Turbo Pascal program. The application software is concerned purely with the application — being an accounting system, word processor, or whatever.

Theoretically, when the application needs to do something involving the physical machine — open a file, read the keyboard, allocate memory — it asks DOS to do the work. DOS is accessed through a series of eight interrupts, with one of them, Int 21, providing over 50 different functions. DOS is concerned with files and other system resources in a very device independent fashion. That is, DOS doesn't tell you (or need to be told by you) whether a disk is a floppy or hard disk, how many sectors per track, how many surfaces, what sort of controller chip is being used, and where that chip is located.

DOS consists of two portions: resident and transient. The resident portion loads into low memory and provides the ablity to deal with the DOS requests an application program may issue. The transient portion loads into high memory and provides the command line parser and the ability to load other programs. The transient portion may be overwritten by memory hungry applications, in which case the resident portion can detect the fact and reload COMMAND. COM when it is next needed. One of the cardinal rules of an MS-DOS machine is that you are never allowed to know where in memory MS-DOS is located. In fact, it is possible to find out, but MS-DOS will not necessarily load into the same position each time the system is booted. Since you don't know where MS-DOS lives, access to it is via the software interrupts.

OEMs, manufacturers of compatible PCs, license MS-DOS from Microsoft. Some OEMs make extensive modifications to the standard MS-DOS before distributing it with their machine. For this reason, Microsoft says that there is no such thing as a 'standard' MS-DOS

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Australian Personal Computer - Resident Clock        Page     1-1

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                              ;          Memory Resident Screen Based Digital Clock
                              ;          Australian Personal Computer Magazine.
                              ;          October, 1986.


                              .Sall
                              Pushes     Macro   List
                                         Irp     Reg, <List>
                                         Push    Reg
                                         Endm
                                         Endm


                              Pops       Macro   List
                                         Irp     Reg, <List>
                                         Pop     Reg
                                         Endm
                                         Endm


                              Convert    Macro   Register
                                         Mov     Al,Register
                                         Call    Converter
                                         Endm


0000                          Mainseg    Segment Para
                                         Assume  CS:Mainseg,DS:mainseg,SS:Nothing,ES:Nothing

0100                                     Org     0100h
= 4944                        Stamp      Equ     'ID'
= 0070                        Attrib     Equ     70h

0100                          Clock      Proc    Far
0100  E9 01C4 R                          Jmp     Inits

0103  EB 03 90                Handler:   Jmp     Start
0106  4944                    Marker:    Dw      Stamp
0108  9C                      Start:     Pushf
                                         Pushes  <ax,bx,cx,dx,es,ds,si,di>
0111  0E                                 Push    cs
0112  1F                                 Pop     ds
0113  32 E4                              Xor     Ah,Ah
0115  CD 1A                              Int     1ah            ; Tick count in CX:DX
0117  8B C1                              Mov     Ax,Cx
0119  8B DA                              MOv     Bx,Dx
011B  D1 E2                              Shl     Dx,1
011D  D1 D1                              Rcl     Cx,1
011F  D1 E2                              Shl     Dx,1
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Microsoft (R) Macro Assembler  Version 4.00          10/15/86 15:17:47
Australian Personal Computer - Resident Clock        Page     1-2

0121  D1 D1                              Rcl     Cx,1
0123  03 D3                              Add     Dx,Bx
0125  13 C1                              Adc     Ax,Cx
0127  92                                 Xchg    Dx,Ax
0128  B9 E90B                            Mov     Cx,0e90bh      ; Strip out Hours
012B  F7 F1                              Div     Cx
012D  8B D8                              Mov     Bx,Ax
012F  33 C0                              Xor     Ax,Ax
0131  F7 F1                              Div     Cx
0133  8B D3                              Mov     Dx,Bx
0135  B9 00C8                            Mov     Cx,00c8h
0138  F7 F1                              Div     Cx
013A  80 FA 64                           Cmp     Dl,64h
013D  72 03                              Jb      Decimals
013F  80 EA 64                           Sub     Dl,64h
0142  F5                      Decimals:  Cmc
0143  8A DA                              Mov     Bl,Dl          ; Seconds
0145  D1 D0                              Rcl     Ax,1
0147  32 D2                              Xor     Dl,Dl
0149  D1 D2                              Rcl     Dx,1
014B  B9 003C                            Mov     Cx,003ch
014E  F7 F1                              Div     Cx
0150  8A FA                              Mov     Bh,Dl
0152  F6 F1                              Div     Cl
0154  86 C4                              Xchg    Al,Ah
0156  8B C8                              Mov     Cx, Ax
0158  BE 01A0 R                          Mov     Si, Offset Buffer
                                         Convert Ch
                                         Convert Cl
                                         Convert Bh             ; Convert into display buffer
                                         Convert Bl

016F  B9 000B                            Mov     Cx, 11
0172  BE 01A0 R                          Mov     Si, Offset Buffer
0175  33 FF                              Xor     Di, Di
0177  A1 019E R                          Mov     Ax, [screen]
017A  8E C0                              Mov     Es, Ax
017C  3D B000                            Cmp     Ax, 0b000h
017F  74 08                              Je      Nowait         ; If colour screen
0181  BA 03DA                            Mov     Dx, 3dah
0184  EC                      Wait_horiz: In     Al,Dx
0185  A8 08                              Test    Al,8
0187  74 FB                              Jz      Wait_horiz     ; Then eliminate snow
0189  FC                      Nowait:    Cld
018A  F3/ A5                             Rep     Movsw          ; Copy buffer to screen

                                         Pops    <di,si,ds,es,dx,cx,bx,ax>
0194  9D                                 Popf
0195  2E: FF 2E 019A R                   Jmp Dword Ptr cs:[Chain_Ofs]  ; Chain through

019A  ????                    Chain_Ofs  dw      ?
019C  ????                    Chain_Seg  dw      ?
019E  ????                    Screen     dw      ?
01A0  68 70                   Buffer     db      'h', Attrib
01A2  68 70                              db      'h', Attrib
01A4  3A 70                              db      ':', Attrib
```

```
Microsoft (R) Macro Assembler  Version 4.00          10/15/86 15:17:47
Australian Personal Computer - Resident Clock        Page     1-3

01A6  6D 70                              db      'm', Attrib
01A8  6D 70                              db      'm', Attrib
01AA  3A 70                              db      ':', Attrib
01AC  73 70                              db      's', Attrib
01AE  73 70                              db      's', Attrib
01B0  2E 70                              db      '.', Attrib
01B2  64 70                              db      'd', Attrib
01B4  64 70                              db      'd', Attrib

01B6                          Converter  Proc Near   ; converts AL into DS:SI
01B6  D4 0A                              Aam
01B8  05 3030                            Add  Ax,3030h
01BB  88 24                              Mov  [Si],Ah
01BD  88 44 02                           Mov  [Si+2],Al
01C0  83 C6 06                           Add  Si,6
01C3  C3                                 Ret
                              Converter  EndP


                              ;          ************************
                              ;          * INITIALISE           *
                              ;          ************************

01C4  0E                      Inits:     Push    Cs
01C5  1F                                 Pop     Ds             ; Data addressability via DS

01C6  B8 351C                            Mov     Ax,351ch       ; Find Ticker Vector in ES:BX
01C9  CD 21                              Int     21h
01CB  26: 81 7F 03 4944                  Cmp     Es:[Bx+3], Stamp  ; Are we already loaded?
01D1  74 38                              Je      Already

01D3  8C 06 019C R                       Mov     [Chain_Seg],Es    ; Preserve the Ticker chain
01D7  89 1E 019A R                       Mov     [Chain_Ofs],Bx
01DB  BA 0217 R                          Mov     Dx, Offset Welcome
01DE  B4 09                              Mov     ah,9
01E0  CD 21                              Int     21h            ; Call DOS to display Message

01E2  CD 11                              Int     11h
01E4  BA B000                            Mov     Dx, 0b000h
01E7  24 30                              And     Al, 30h
01E9  3C 30                              Cmp     Al, 30h
01EB  74 03                              je      Mono_Screen
01ED  BA B800                            Mov     Dx, 0b800h
01F0  89 16 019E R            Mono_Screen: Mov   [Screen],Dx    ; Set Screen base address
01F4  BA 0103 R                          Mov     Dx, Offset Handler
01F7  B8 251C                            Mov     Ax, 251ch      ; Get Dos to reset Tick Vector
01FA  CD 21                              Int     21h
01FC  B8 3100                            Mov     Ax,3100h
01FF  BA 01C4 R                          Mov     Dx, Offset Inits
0202  B1 04                              Mov     Cl, 4
0204  D3 EA                              Shr     Dx, Cl
0206  83 C2 10                           Add     Dx, 10h
0209  CD 21                              Int     21h            ; Terminate & Stay Resident
```

```
Microsoft (R) Macro Assembler  Version 4.00          10/15/86 15:17:47
Australian Personal Computer - Resident Clock        Page     1-4

020B  BA 0235 R               Already:   Mov     Dx, Offset Error
020E  B4 09                              Mov     Ah,9
0210  CD 21                              Int     21h            ; Call DOS to display message
0212  B8 4C00                            Mov     Ax,4c00h
0215  CD 21                              Int     21h            ; Exit without a trace

0217  0D 0A 41 50 43 20 43    Welcome    db      0dh,0ah,'APC Clock is now resident',0dh,0ah,'$
      6C 6F 63 6B 20 69 73
```

```
      20 6E 6F 77 20 72 65
      73 69 64 65 6E 74 0D
      0A 24
0235  0D 0A 07 43 6C 6F 63     Error        db     0dh,0ah,07h,'Clock already loaded',0dh,0ah,'$'
      6B 20 61 6C 72 65 61
      64 79 20 6C 6F 61 64
      65 64 0D 0A 24


                               Clock        EndP
024F                           MainSeg .    EndS
                                            End    Clock

Microsoft (R) Macro Assembler  Version 4.00                 10/15/86 15:17:47
Australian Personal Computer - Resident Clock               Symbols-1


Macros:

                N a m e                Lines

CONVERT . . . . . . . . . . . .          2
POPS . . . . . . . . . . . . . .         3
PUSHES . . . . . . . . . . . . .         3

Segments and Groups:

                N a m e                Size    Align   Combine Class

MAINSEG . . . . . . . . . . . .        024F    PARA    NONE

Symbols:

                N a m e                Type    Value   Attr

ALREADY . . . . . . . . . . . .        L NEAR  020B    MAINSEG
ATTRIB . . . . . . . . . . . . .       Number  0070

BUFFER . . . . . . . . . . . . .       L BYTE  01A0    MAINSEG

CHAIN_OFS . . . . . . . . . . .        L WORD  019A    MAINSEG
CHAIN_SEG . . . . . . . . . . .        L WORD  019C    MAINSEG
CLOCK . . . . . . . . . . . . .        F PROC  0100    MAINSEG Length = 014F
CONVERTER . . . . . . . . . . .        N PROC  01B6    MAINSEG Length = 000E

DECIMALS . . . . . . . . . . . .       L NEAR  0142    MAINSEG

ERROR . . . . . . . . . . . . .        L BYTE  0235    MAINSEG

HANDLER . . . . . . . . . . . .        L NEAR  0103    MAINSEG

INITS . . . . . . . . . . . . .        L NEAR  01C4    MAINSEG

MARKER . . . . . . . . . . . . .       L NEAR  0106    MAINSEG
MONO_SCREEN . . . . . . . . . .        L NEAR  01F0    MAINSEG

NOWAIT . . . . . . . . . . . . .       L NEAR  0189    MAINSEG

SCREEN . . . . . . . . . . . . .       L WORD  019E    MAINSEG
STAMP . . . . . . . . . . . . .        Number  4944
START . . . . . . . . . . . . .        L NEAR  0108    MAINSEG

WAIT_HORIZ . . . . . . . . . . .       L NEAR  0184    MAINSEG
WELCOME . . . . . . . . . . . .        L BYTE  0217    MAINSEG


    183 Source  Lines
    213 Total   Lines
     44 Symbols

  49332 Bytes symbol space free

      0 Warning Errors
      0 Severe  Errors
```

LISTING ONE

```
100 '             Australian Personal Computer Magazine
110 :
120 '             =====================================
130 '
140 '                  .COM & .EXE file Generator
150 '                  --------------------------
160 '
170 '
180 DEFINT A-Z
190 READ FILENAME$
200 KILL FILENAME$
210 OPEN FILENAME$ AS #1 LEN=1
220 FIELD #1, 1 AS OUTPUT$
230 COUNTER = 0
240 PRINT "Generating....."
250 READ LINE.IDENT$
260 IF LINE.IDENT$ = "END" THEN GOTO 430
270 CHECKSUM=0
280 BYTE.POS=0
290 READ ITEM$
300 IF ITEM$ = "$" THEN GOTO 390
310 BYTE = VAL("&h"+ITEM$)
320 BYTE.POS=BYTE.POS+1
330 COUNTER = COUNTER + 1
340 CHECKSUM=CHECKSUM + (BYTE.POS * BYTE)
350 IF CHECKSUM > 9999 THEN CHECKSUM= CHECKSUM - 9999
360 LSET OUTPUT$=CHR$(BYTE)
370 PUT #1
380 GOTO 290
390 READ VERIFYSUM
400 IF CHECKSUM = VERIFYSUM THEN GOTO 250
410 PRINT "Incorrect data at DATA line commencing "; LINE.IDENT$
420 STOP
430 READ SIZE
440 IF SIZE = COUNTER THEN GOTO 490
450 PRINT "Error - bytes missing."
460 PRINT "Expected "; SIZE; " bytes, only read ";COUNTER
470 STOP
480 CLOSE #1
490 PRINT "Generated file "; FILENAME$
500 END
```

LISTING TWO

from the internals point of view. However, every MS-DOS you use should employ the same interrupts and functions for the same purpose with the same parameter conventions.

DOS, in turn, passes requests down to the Bios.

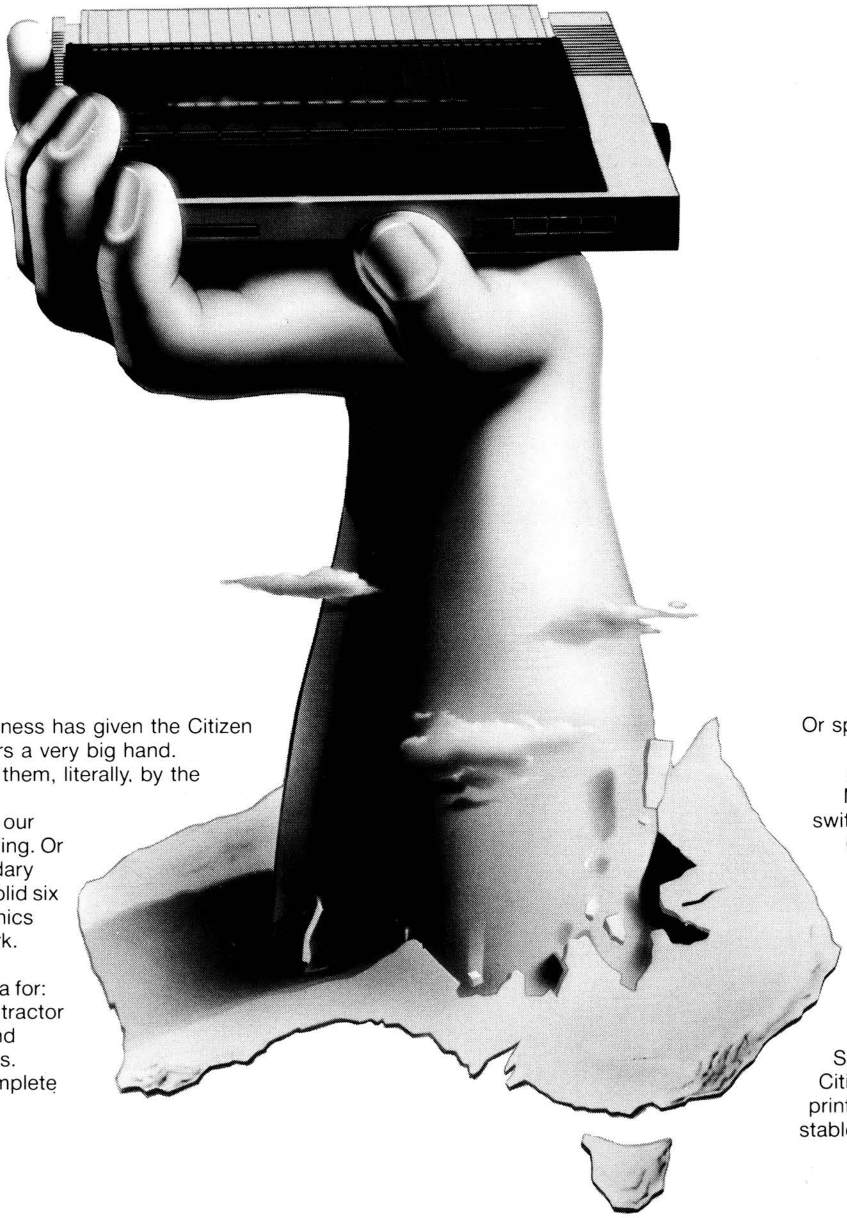
The Bios is implemented in permanent ROM, and knows all about the hardware in intimate detail. It knows where the FDC chip is located and what type of chip has been used; it also knows how to self test the machine and how to bootstrap MS-DOS. Although the Bios is in ROM, interrupt vectors are used to point to the various routines. This means that the location of a Bios routine may be different in different machines, but as long as the same interrupt numbers are used and the parameters are the same, the Bios may be considered to be compatible. When a diskette boots, modifications to be Bios may be loaded into RAM and the interrupt table altered to point at the new routines. This allows Bios bugs to be corrected, and also allows system programmers to intercept Bios calls.

Figure five shows the hierarchy of the software architecture. In well behaved software, calls flow down from the application through DOS and the Bios to the hardware, and the results then flow back to the application by following the same path in reverse.

The exciting point about all this is that since the machine is a PC, we can get involved at any point along the way. We can alter the requests, ignore them, do something different or just report on them. We can do this, not only for diskette calls, but for anything going on in the system (as well as things which normally don't go on in the system). This means that we can make an otherwise lame PC sing and dance.

Most software gets involved at all three levels. For example, a good communications package would use MS-DOS calls to access files and read the keyboard, Bios routines to access the asynch port, and go direct to hardware for screen I/O and possibly for access to the UART. Even a product which stays religiously to the MS-DOS call level, such as dBase, gets right down to hardware level for its security validation. The humble WordStar is another which mainly keeps to the MS-DOS level, yet it calls the Bios to do printing.

At this point, it is interesting to introduce the issue of IBM compatibility.



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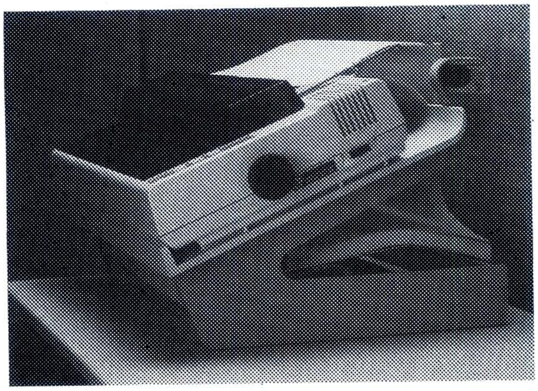

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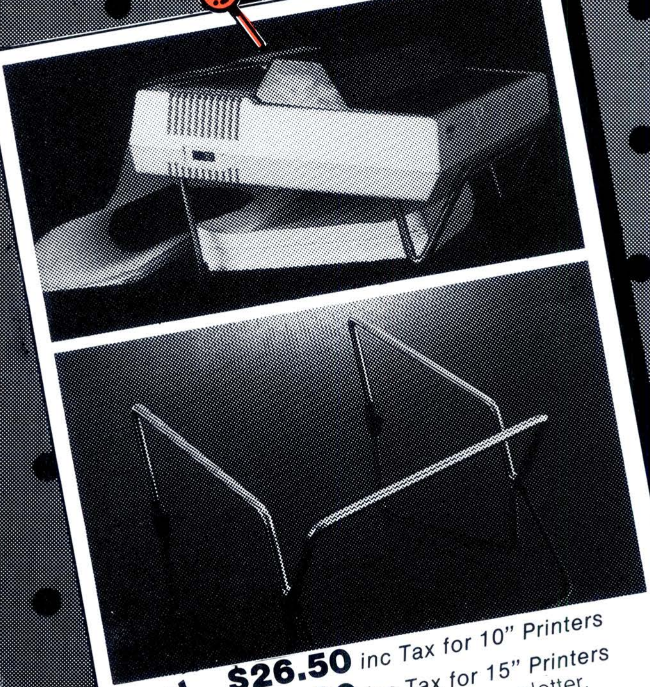

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* Joystick port
* Light pen port
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* Sculpted ergonomic keyboard
* 4 layer board for reliability

```
1000 DATA   "clock.com"
1010 DATA  1 , E9, C1, 00, EB, 03, 90, 44, 49, 9C, 50, 53, 51,  $,  7587
1020 DATA  2 , 52, 06, 1E, 56, 57, 0E, 1F, 32, E4, CD, 1A, 8B,  $,  7720
1030 DATA  3 , C1, 8B, DA, D1, E2, D1, D1, D1, E2, D1, D1, 03,  $,  3940
1040 DATA  4 , D3, 13, C1, 92, B9, 0B, E9, F7, F1, 8B, D8, 33,  $,  2558
1050 DATA  5 , C0, F7, F1, 8B, D3, B9, C8, 00, F7, F1, 80, FA,  $,  4572
1060 DATA  6 , 64, 72, 03, 80, EA, 64, F5, 8A, DA, D1, D0, 32,  $,  2379
1070 DATA  7 , D2, D1, D2, B9, 3C, 00, F7, F1, 8A, FA, F6, F1,  $,  5296
1080 DATA  8 , B6, C4, 8B, C8, BE, A0, 01, 8A, C5, E8, 56, 00,  $,  9803
1090 DATA  9 , 8A, C1, E8, 51, 00, 8A, C7, E8, 4C, 00, 8A, C3,  $,  164
1100 DATA 10 , E8, 47, 00, B9, 0B, 00, BE, A0, 01, 33, FF, A1,  $,  9035
1110 DATA 11 , 9E, 01, 8E, C0, 3D, 00, B0, 74, 08, BA, DA, 03,  $,  8185
1120 DATA 12 , EC, A8, 08, 74, FB, FC, F3, A5, 5F, 5E, 1F, 07,  $,  9068
1130 DATA 13 , 5A, 59, 5B, 58, 9D, 2E, FF, 2E, 9A, 01, 00, 00,  $,  5503
1140 DATA 14 , 00, 00, 00, 00, 68, 70, 68, 70, 3A, 70, 6D, 70,  $,  7001
1150 DATA 15 , 6D, 70, 3A, 70, 73, 70, 73, 70, 2E, 70, 64, 70,  $,  7881
1160 DATA 16 , 64, 70, D4, 0A, 05, 30, 30, 88, 24, 88, 44, 02,  $,  5193
1170 DATA 17 , 83, C6, 06, C3, 0E, 1F, B8, 1C, 35, CD, 21, 26,  $,  6439
1180 DATA 18 , 81, 7F, 03, 44, 49, 74, 38, 8C, 06, 9C, 01, 89,  $,  6506
1190 DATA 19 , 1E, 9A, 01, BA, 17, 02, B4, 09, CD, 21, CD, 11,  $,  7178
1200 DATA 20 , BA, 00, B0, 24, 30, 3C, 30, 74, 03, BA, 00, B8,  $,  6817
1210 DATA 21 , 89, 16, 9E, 01, BA, 03, 01, B8, 1C, 25, CD, 21,  $,  6359
1220 DATA 22 , B8, 00, 31, BA, C4, 01, B1, 04, D3, EA, 83, C2,  $,  1341
1230 DATA 23 , 10, CD, 21, BA, 35, 02, B4, 09, CD, 21, B8, 00,  $,  7077
1240 DATA 24 , 4C, CD, 21, 0D, 0A, 41, 50, 43, 20, 43, 6C, 6F,  $,  5651
1250 DATA 25 , 63, 6B, 20, 69, 73, 20, 6E, 6F, 77, 20, 72, 65,  $,  7111
1260 DATA 26 , 73, 69, 64, 65, 6E, 74, 0D, 0A, 24, 0D, 0A, 07,  $,  3094
1270 DATA 27 , 43, 6C, 6F, 63, 6B, 20, 61, 6C, 72, 65, 61, 64,  $,  7585
1280 DATA 28 , 79, 20, 6C, 6F, 61, 64, 65, 64, 0D, 0A, 24,      $,  4158
1290 DATA END,  335
```

LISTING THREE

Machines which provide only MS-DOS support can run only software which keeps to the MS-DOS level, ie, not much. Machines which also provide Bios level compatibility will generally run most software, but will fail security disk validations.

For a machine to be truly compatible, it must not only run MS-DOS, but also faithfully reproduce the Bios, so that not only do the same interrupt numbers do the same things, but they also pass parameters through the same registers. Additionally, the machine must have its devices (FDC, screen, keyboard controller, and so on), mapped to the same I/O port addresses, and must use controller chips which are functionally identical to those found in the IBM PC. For example, I once had problems with communications software on a Taiwanese machine because the manufacturers used a slightly different UART chip which functioned identically except for not clearing out the error reason bits when the error bit was not on.

The vast majority of machines calling themselves compatible adhere to the IBM standards. Some do not, and these seem to have drifted away quietly.

Calling the system

All calls to both the DOS and Bios are made through the software interrupts. This is achieved by loading up various CPU registers with codes and pointers, and then executing a software interrupt. The interrupt is generated by an 808X instruction. The instruction is two bytes long, with the second byte indicating which interrupt is to be performed, for example, Int 21h. Not all high level languages provide the ability to write machine language intermixed with normal statements, however, most provide a facility for calling external subroutines written in any language. This can be used to create an assembly language subroutine which issues the interrupt and returns the result to the high level program. Turbo Pascal provides a very good facility for loading registers and making interrupts, and is possibly one of the best languages for DOS and Bios experiments.

Although it is possible to call DOS from a high level language, no high level language is well suited to becoming part of DOS or the Bios. For this, assembler is needed as absolute control over the registers is required.

A good understanding of how the software levels and hardware interact can be achieved by following the flow of events when an application program requests a DOS function, for example opening a file.

Initially, the application program creates a buffer containing the name of the file. It points the registers DS;DX at the buffer, loads AL with an access mode, and AH with the value 3Dh. It then performs an INT 21h. Software interrupt number 21h is the main DOS function dispatcher, and uses the contents of AH to determine what function is being requested — in this case, 3Dh, which opens a file.

The function dispatcher must then search the directory, either use or create a directory entry for that file, and hand a return code back to the application program. To read and write the directory, the function dispatcher calls another part of DOS, INT 25h and INT26h. These functions provide a read sector/write sector interface based on simple sector numbers, that is, it doesn't matter what sort of disk it is, how many sectors per track or how many surfaces. Sectors are numbered from zero through to the end.

INT 25h and INT 26h then pass control to the ROM Bios. This is done through interrupt number 13h, and DOS must translate its simple sector number

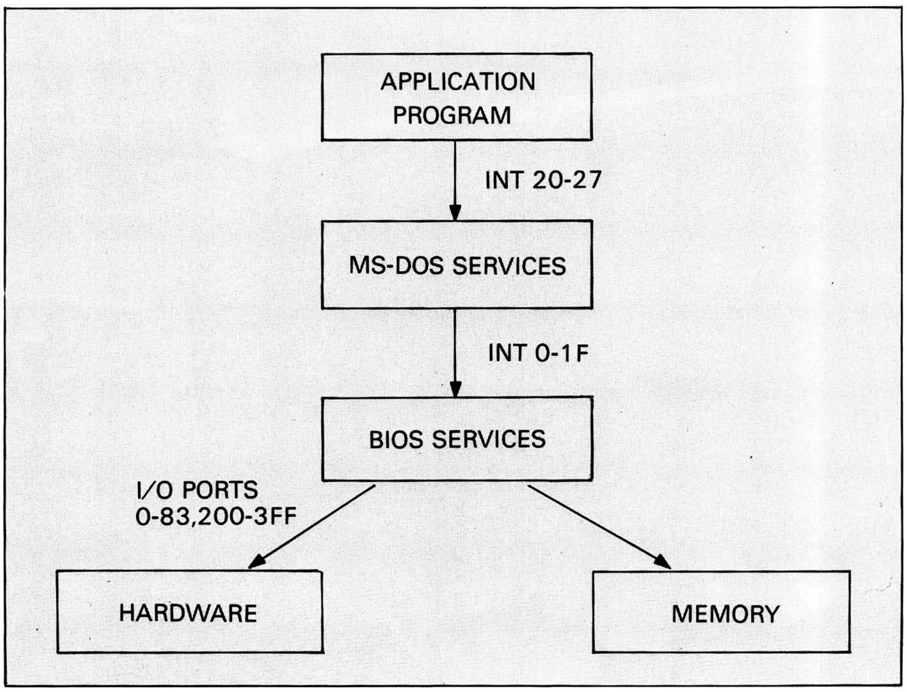

Fig 4: The software architecture

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into a head number, track number and sector within track number. Since the Bios deals directly with the hardware, it needs the request in terms it can understand, that is, relevant to the type of disk drive attached.

The Bios diskette handler, INT 13h, then starts sending a series of bytes to the I/O ports 3F8 to 3FF. The floppy disk controller chip (FDC) is attached to these ports, and it can control the physical drive. The ROM Bios issues a series of commands through I/O port 3F8, making the FDC start the drive, seek to the relevant track, read a sector and pass it back.

Control then flows back up through the structure, passing return codes all the way.

Example: resident software

This month, we offer a small program which makes use of both DOS and Bios functions to terminate and stay resident. The program produces a digital clock located in the top left corner of the screen. The clock is updated continuously no matter what your machine is doing, and is accurate to one hundredth of a second.

The program is intended as a taste of things to come, and hence we will not be getting too involved with explanations of how it works and why it does what it does. The facilities used by the program will be revisited later in the series, with full explanations at that time.

Broadly, however, the program consists of two parts. The first part is executed when the program is first run, and hooks the second part of the program up to the system ticker. The ticker is an interrupt which is called 18.2 (approx) times per second. The program then determines what type of screen is connected and terminates but stays resident, disposing of those pieces of itself which will no longer be needed.

The second portion is called by the ticker, and 18.2 times each second calls a Bios service to determine the number of ticks since midnight. It converts this tick count to a time in HH:MM:SS.DD format, and displays the result on the screen. On colour screens, snow is avoided by waiting until the horizontal retrace period.

This program should run successfully on most IBM PCs and true compatibles. Some customised DOSs may present problems as they maintain the system time in a different way. If your machine is one of these, the symptom will be that the time displayed is not necessarily the time DOS thinks it is.

Running the example

Almost all of the programs presented in this series will be written in assembler, as it is the only language suitable for low level operating system work. However, for readers without an assembler, we do provide an alternative method of loading the software.

Listing one shows the assembler code for the resident clock. The assembler used was Microsoft MASM version 4, but another assembler could serve equally well. Readers with an assembler should simply type this program into a file, for example CLOCK.ASM, and then compile and link it using the following commands:

```
MASM CLOCK;
LINK CLOCK;
EXE2BIN CLOCK
DEL CLOCK.EXE
```

These commands will result in a CLOCK.COM file which can be immediately run. Be sure you enter the program correctly, as any mistakes are likely to cause a system crash.

For readers without an assembler, we are using a technique this publication and its sister publications have employed for many years. Listing two shows a Basic program written for the GW-BASIC, BASICA or BASIC interpreters. This program forms the basis of a 'loader' which can be used each month with any of the programs we present. Listing three is a set of DATA statements which, when combined with the loader, will generate CLOCK.COM.

Be sure that you enter the DATA statements correctly. If any of your DATA statements are incorrect, the loader will probably detect it as it verifies the total number of bytes and a checksum for each line. The first element in each line is a line identifier which can be used to locate errors, and the last element is a checksum. The checksum is positionally weighted, so a transposition error will generally be detected. Once you have entered this program, simply RUN it and, if it were entered correctly, it will generate CLOCK.COM. You can then exit from Basic back to DOS and run CLOCK.COM. There is no difference between the CLOCK.COM produced by an assembler and the one produced by Basic, except that readers with assemblers will be able to modify and enhance the program.

When you have generated CLOCK.-COM, keep your Basic program, as next month you can simply delete the old DATA statements, type in the new ones, and generate the next program.

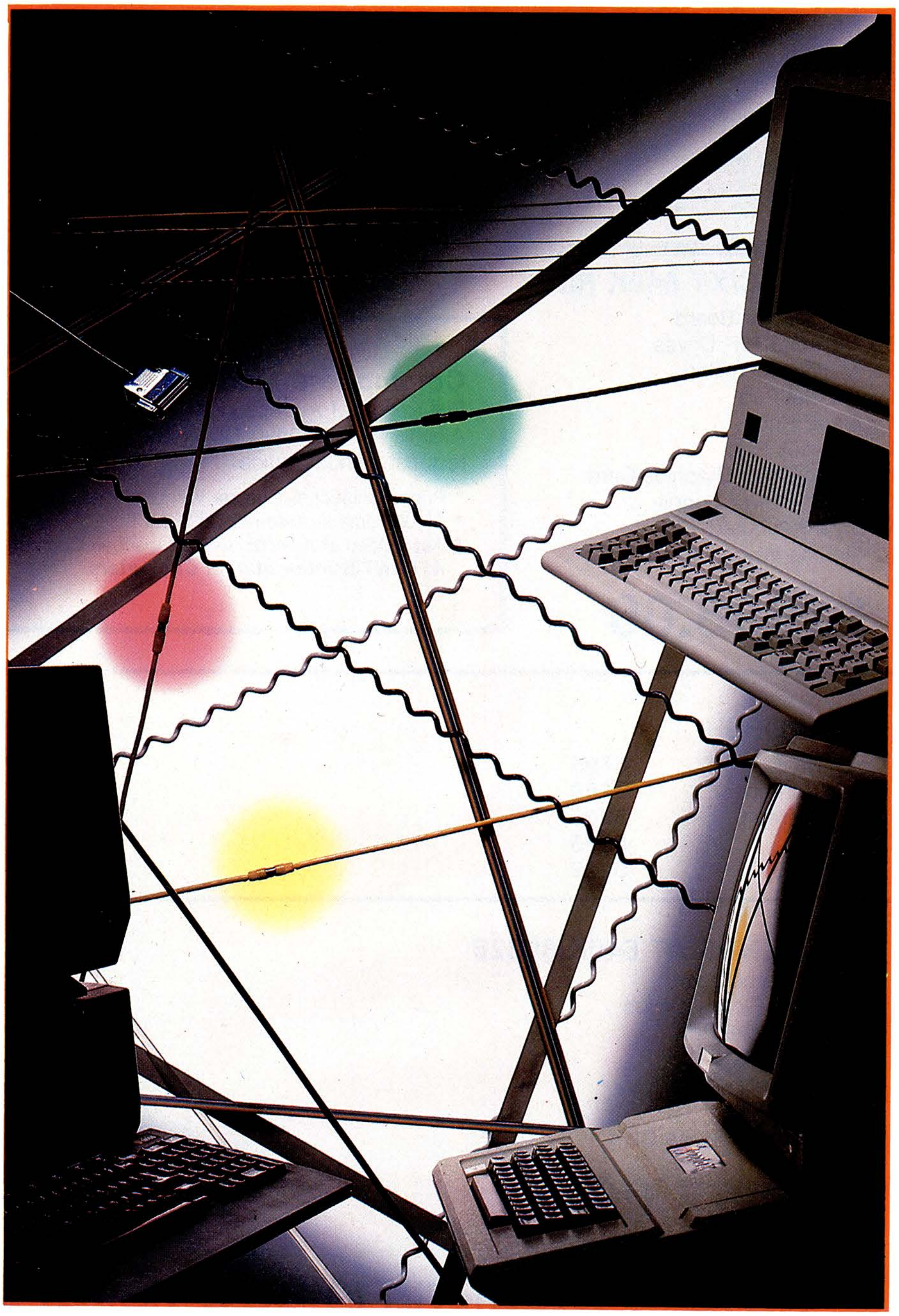
This program is also available as telesoftware on Viatel. In case you haven't got into Viatel yet, it's probably worth a mention. No one really likes typing in long programs and trying to get them right. Through the use of Telecom Viatel, you can connect your machine via a modem to Microtex 666, Viatel's largest service provider, and download software through the telephone. Microtex has over 20,000 pages of telesoftware for a wide variety of machines including the PC. Some of the software is free, others are charged small fees, usually a dollar or two. The best part is, since the software is delivered electronically, no sales tax is payable! In addition to telesoftware, Microtex (and Viatel in general) provide a host of useful services, activities, social involvements and information.

Next Month

Next month the introduction continues with a look at the 808X processor, the Bios routines, DOS interrupts and DOS functions. Following the completion of this ground-work, we'll be getting stuck into lots of resident software, drivers, hypervisors and pop-up utilities. By the time you've finished the series, you'll be able to build a Sidekick with your eyes closed.

END

Spinning the Token Ring



At long last IBM's Token Ring has arrived. In the second part of our look at networks Paolo Baccanello sees it in action.

Unlike PC network, IBM's Token Ring is an unexceptional product. It is unexceptional in the sense that, like so many of IBM's hardware products, it looks set to become a standard. Since it was announced in the spring of 1985, major participants in the PC LAN market (such as 3Com, Excelan, Bridge Communications, Corvus, Gateway, Nestar and Novell) have either announced compatible products, or gateways between Token Ring and their own established Ethernet or TCP/IP-based products.

Given PC Network's failure to excite an obviously discerning market, why the interest in Token Ring? In order to understand this we visited an actual installation to take a closer look at IBM's Token Ring in action.

On the hardware side, IBM's Token Ring consists of three basic components — adaptor card, cable and wiring concentrator. The adaptor card is sparsely populated, with a Texas Instruments RM 380 chip set providing the communications capability and a 9-pin D-type plug making the connection at its exposed end. It fits into a full length expansion slot inside the PC's system unit and costs $1338.

Before you physically install the card in your PC, two blocks of DIP switches can be set to take into account any exotic configurations. Switches on one block allow you to determine where within the PC's memory the card's instruction code will be located and how it communicates with the PC's CPU. These need to be reset if you are installing the Token Ring adaptor card alongside a 3278-9

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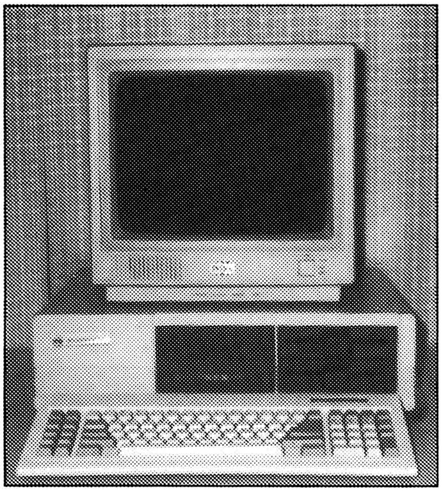

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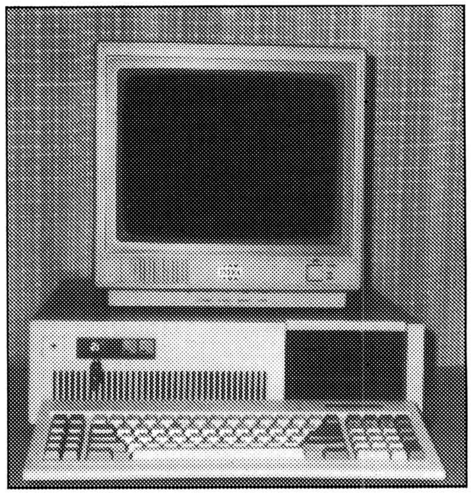

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emulator or any other communications cards, whether asynchronous, SDLC (synchronous data link control), BSC (bysynchronous communications) or PC Network. The second block of switches allows you to fit a second back-up Token Ring network adaptor card in either an XT or AT.

Once the card is installed you need to connect it up to an 8228 multiple access unit costing $1388. This is a small, rugged box-like affair, 48.3 cms wide, 6.7 cms high and 20 cms deep. It has a flip-top front panel and cable-guides on either side. The 8228 is the linchpin in the Token Ring network.

There are 10 identical sockets arranged in a row hidden away behind the front panel. Each is linked to the other internally by set 'intelligent' relays. Externally, eight of the sockets connect directly to PCs while the other two, labelled RI (Ring In) and RO (Ring Out), connect up to other 8228 units to form a closed loop. On a large network the overall impression would be a ring of 8228s with PCs radiating out from each 8228 like spokes in a wheel. This is known as a star-wired ring.

The cabling used to connect PCs to the 8228, and 8228s to each other, varies depending upon the distance information has to travel and the number of stations to be installed. On the system tested by us, IBM type-6 cable was used. This is two sets of twisted-pair cable — one for receiving information and the other for sending it.PCs can be located up to 120 metres from the 8228 and up to 33 8228s can be located 45 metres from each other.

For larger installations IBM suggests an alternative and much more expensive cabling scheme. Here buildings are pre-wired using IBM-type-1 cabling with wall sockets for individual PCs and with the cabling behind the walls gathered up into wiring closets in which 8228s are stacked in eight rows of eight. The closets themselves may then be attached by a single connection.

Using this scheme a total of 264 PCs can be connected, with PCs located up to 100 metres from the nearest wiring closet. The closets themselves can be located within 200 metres of each other. Using cheaper type-3 cable, the figures drop to 72 stations on the ring with PCs located within 45 metres of the appropriate closet and with closets less than 120 metres apart.

Once you have decided on the size of the ring you want and have connected the various bits and pieces of hardware and cable together, the next step is to switch the network 'on'. This is done by running a special network interface program on each station. It is supplied on disk and may be copied onto hard disk and run directly by issuing the command TOKREUI from a batch file. The program first checks that the adaptor in your workstation is working and then sends a 5-volt current down the cable to the 8228, which audibly clicks as the connection onto the ring is opened up. The process takes some 45 seconds and requires no operator intervention.

Once the workstation is physically locked on to the ring the next step is to load IBM's Netbios system, also supplied on disk. This is the software that makes the network compatible with PC-DOS and takes care of the interception of network requests and their routing to the appropriate workstation.

Our final step in getting the network up and running was to load IBM's PC Network program. This provides a user interface to the network and is used to determine which of the workstations would act as a concurrent file server and exactly which resources would be shared, and by whom. After this we were able to run a number of applications including Lotus 1-2-3, DisplayWrite III, and WordStar. With the exception of Lotus, which required a copy-protected system disk and was not multi-user, the programs were loaded directly from the file server's hard disk and ran on the multiple stations without problems sharing data.

Satisfied that the Token Ring worked, we turned our attention to its performance. The best throughput was achieved by configuring the system so that information was passed down the lines via Netbios in 16k chunks. Here there was a performance of 800kb/s which compared favourably with similar tests carried out on a more expensive Ethernet-based LAN with a raw bit rate of 10Mb/s, and a throughput when similarly configured of 1Mb/s.

Throughput figures remained stable and did not tend to fluctuate as activity levels varied between workstations. This provided a clear indication that the theory behind token-passing protocols was indeed working in practice.

A traditional weakness of ring LANs is that if one station goes down then the whole ring collapses, as each workstation effectively acts as a repeater, retransmitting the token and any attached data to its immediate neighbour. This situation is compounded by the fact that the only way to diagnose which station is faulty is to test each link in the chain individually. It is rather like wiring up a Christmas tree with fairy lights; if just one light is faulty none will light up.

IBM has neatly sidestepped these pro-


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blems by opting to star-wire PCs in batches of eight around 8228 multiple access units instead of simply linking each one to the next, and by organising workstations in such a way that each monitors the operation of its immediate neighbours.

Each Token Ring adaptor card has its own unique identity number. When a PC is first connected up to the ring this is transmitted to its immediate neighbour. If the PC either fails to transmit a signal for a set period of time or when its signal is distorted, its neighbour then broadcasts this fact, along with the faulty PC's identification number, down the ring. It is passed from one workstation to the next until it reaches the offending PC. This reads the message, realises that it's not functioning properly and breaks the connection between itself and the 8228. The faulty PC then goes into self-test while other workstations remain connected via the 8228 and continue to function normally.

With faulty workstations automatically popping in and out of the ring, token integrity becomes a problem. On IBM's ring this is resolved by monitoring the Token itself as it goes round the ring. The token's passage is timed. If no token appears within the maximum length of time required to complete one circuit of the ring, it is assumed lost. In this case a new token is then automatically generated. Also, if a busy token completes more than a single circuit of the ring it is automatically 'freed'.

Like most of IBM's hardware, Token Ring is supplied with a set of diagnostic routines on disk. Intended to give you sufficient information to pass onto IBM's engineers, the routines are menu-driven and require a minimum of operator intervention. They first check to see what primary and alternative adaptors are installed and then perform multiple tests to determine the source of the error (for example whether the PC itself, the network adaptor card or the adaptor interface software is at fault).

The results of diagnostic tests appear, for the most part, in hex and take the form of a mini-report which can be logged and printed out. The report begins with the adaptor's unique identification number (12 digits) and gives further information relating to ROM addresses, code and interrupt levels. These are determined by the DIP setting switches on the card. Status and error messages comprising a terse message plus a 5-digit code make up the rest of the report.

These reports, which give information about the location of faulty workstations on the LAN, could well prove a godsend to experienced network managers overseeing large installations but are unlikely to help the inexperienced.

Conclusion

Overall IBM's Token Ring is a simple scheme that combines the benefits of both star and ring topologies. On the one hand, token passing provides a reliable and ordered way of transmitting informa tion between workstations where response times are constant, and are determined only by the number of workstations installed and not by the level of activity. As implemented by IBM it ensures a relatively high level of throughput (approximately 800 kilobytes per second) suitable for running most office automation applications despite much lower raw bit rates (4 megabytes per second) than standard

TOKEN RING PRICE LIST

Description	Price
Hardware	
8228 Multistation Access Unit	$1388
Network Adaptor Card	$1338
Cabling	
8-foot Network Adaptor Cable	$87
Software (per station)	
Netbios program	$71
PC Network program	$143
Enhanced PC Network (LAN) program	$238
IBM Token Ring Network Manager	$2978
PC DOS 3.2	$196

Manufacturer: IBM

THIRD-PARTY COMPATIBLE PRODUCTS

3 Com
Token Ring interface for 3 Com Server, adaptor board and 3+ Networking Software

Corvus
Gateway to OmniNet

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Token Ring interface for Plan series of file servers

Novell
Advanced Netware for Token Ring and Software Bridge to run Netware compatible application on any other network supporting Netware

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Ethernet-based LANs (10 Mb/s).

On the other hand, by star-wiring its LAN with a single cable, IBM has struck a fine balance between the use of dedicated lines for network control and shared lines for cheaper installation costs. It manages to incorporate a power set of autonomous facilities for detecting and correcting transmission errors.

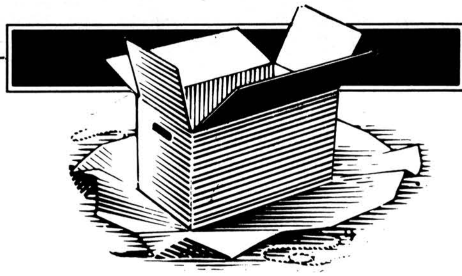
Although Token Ring, with its dedicated lines linking PCs to 8228s and its need to close the loop where more than one 8228 is in use, will require more cabling than your average Ethernet-type bus network, the extra has been kept to a minimum.

On the software side, Token Ring's dependence upon Netbios and IBM,'s PC Network Program is a mixed blessing. Using Netbios does have the advantage that Token Ring is PC Network compatible and that all programs that ran on the latter will run on the former. Also, because the Token Ring adaptor card has been designed to support an alternative IBM networking/communication card and Netbios supports communications between 'linked' stations running multiple applications off multiple adaptors, existing PC Network users will benefit from an upgrade path that does not render their existing investment in IBM LAN hardware obsolete.

However, the disadvantages of Netbios are that, while it supports 3270 emulation, it is at present incompatible with IBM's SNA architecture which provides a much more flexible entry point into the IBM mainframe world. Also, the way in which Netbios requires devices on the LAN to broadcast their presence makes it unsuitable for internetworking.

As for IBM's PC Network program, despite being good value at $143 per terminal, it is not suitable for large or secure installations. Password protection and access permissions are limited and the program only recognises different devices and not users. Fortunately IBM intends to release an enhanced version of the PC Network Program ($238) as well as a full network management package ($2978) which is udnerstood to be on a par with Novell's Advanced Network package that currently sets the standard in LAN management software. END

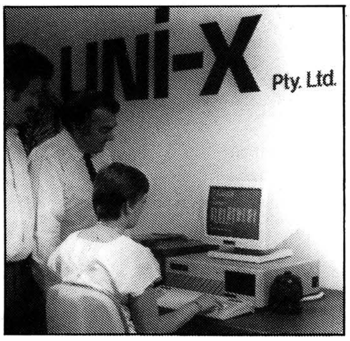
A table of networking products with specifications will appear in the December issue of APC.



WHAT'S NEW

Ian Davies checks out the most interesting new micro products announced over the last month.

Microcomputers



AT-S from UNI-X

This AT compatible boasts 1Mbyte of RAM on the motherboard, a dual speed 80286 processor and a system reset button on the front panel. One of its main features is the small footprint, as the system only occupies about as much desk space as an XT.

With a 20Mbyte hard disk, the AT-S sells for around $5,300. With the addition of a colour monitor and CGA/MDA/EGA card, the price goes up to just under $7000.

For more information, call UNI-X on (07) 356 7866.

More VoiceWriters

Following on from last month's report on the Kurzweil VoiceTerminal, an American company called Microphonics Technology has introduced its own VOX/COM PC.

This machine would appear to be very similar to the Kurzweil job. It is an XT compatible with a 20Mbyte hard disk and modem. Unlike the Kurzweil offering, Microphonics is long in describing its PC type features and modem capabilities, but very short on its ability to understand a spoken voice.

It does say, however, that it utilises the Pronounce voice control system which gives you the ability to control MS-DOS software using spoken commands.

In the next few months, or certainly within a couple of years, IBM will probably come out with one of these devices. Then we'll really have something to talk about.

80386 LISP Board

Not yet available in Australia, the Gold Hill Computer Company has released an 80386 based enhancement board for PCs, XTs, ATs and compatibles which runs the Golden Common LISP development system.

The board, called the 386 HummingBoard, runs GCLISP five times faster than an AT. The 80386 is driven at 16MHz and may be supplemented by up to 24Mbytes of 32 bit memory. A 2k high speed cache boosts processor performance, as does multi-buffered nonsuspensive I/O which allows the processor to continue running while I/O is taking place.

The board costs $US7000, which is about twice the price of an AT over there.

Porchester Turbos

Porchester Computers has announced the availability of two Turbo boards for IBM PCs, XTs and compatibles.

The TinyTurbo 286 contains a high speed 80286 processor which outperforms the IBM AT and can be located in a half sized expansion slot. The TurboEGA provides the same accelerator, but also includes an EGA compatible display adaptor. The adaptor is also said to be compatible with CGA, MDA and Hercules standards.

Porchester is on (03) 537 2722.

New Beeb

Barson Computers has launched the BBC Compact, a slimmer yet more powerful version of the popular BBC which now sports a lower price tag.

The Compact includes a standard numeric keypad, 128k RAM and bundled software. For $1332, you get all this plus a disk drive, WIMPs software, word processor, database, note pad, tutorial, games, Basic and printer interface.

For network environments, a $970 version of the Compact is also available without the disk drive. To this, the $85 Econet software may be added. Other options include an RS-232C interface.

Barson Computers may be contacted on (03) 419 3033.

More AT Compatibles

Another month has passed with the list of AT compatibles growing with the voracity of mould on the bathroom wall.

Each of these machines offers unparalleled price/performance, unique features, brand name recognition, high performance and 100 per cent compatibility.

This months list includes the Tandy 3000, Osborne AT, Osborne AT Turbo, A*Star II from KCM, Televideo TeleCat, Dick Smith Multitech PC/900 and the Zenith AT.

Software

Pascal Utilities

Microway has secured distribution rights for a range of Pascal utilities and productivity aids.

Turbo Professional is a suite of utilities for Turbo Pascal developers which includes features such as keyboard macros, DOS

- Extremely easy to learn and use
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program execution, concurrent printing, resident programs, pop-up menus and interrupt service routines. Turbo Professional is priced at $196 plus sales tax.

Other products include Turbo Extender, TurboPower Utilities, and Alice. Alice is a syntax directed editor which uses a 'fill in the blanks' approach to program entry and editing. Alice includes a debugging interpreter.

Microway is on (03) 555 4544.

Prime Macintoshes

Users can now integrate Apple Macintosh micros and Prime minicomputers through a new communications product from Prime.

Primelink, previously available for IBM PCs, has now been ported to the Mac. This software allows Mac users to access Primos files and issue Primos commands, as well as transfer files between the two. Additionally, a virtual disk facility is included which enables Mac files to reside on the central machine. Primelink also provides PT200 terminal emulation and allows Primos files to be printed on the Imagewriter and Laserwriter printers.

More information is available from Prime Computer, on (02) 929 0044.

Multi-User MS-DOS

SPS Software Product Support has secured distribution rights for the PC-MOS/386 operating system produced by The Software Link.

PC-MOS/386 is an MS-DOS compatible operating system specifically designed to take full advantage of the 80386 processor, including multi-user support. SPS says that PC-MOS/386 offers more than MS-DOS version 5 is likely to offer because of Microsoft's Xenix involvement and its relationship with IBM.

The operating system will be completely independent of MS-DOS and offers record and file locking, inter-task communication, print spooling, remote access, usage statistics and security. It is expected to be available in February, 1987, although some components have already been demonstrated to 80386 vendors.

SPS may be contacted on (02) 419 5879.

Personnel System

Infolink Software has released a new human resources management and accounting system which will enable managers to maintain complete employee records on an IBM PC. The system, called Stahr, is designed for companies with between 200 and 1000 employees.

The system, developed in Australia and based on the Data Ease DBMS, provides functions for vacancies, sick leave, vacation, entitlements, award rules, training and employee history. A position management facility keeps track of the various positions within an organisation, and allows for their maintenance.

The system runs on IBM PCs and compatibles, and costs around $20,000, including a basic machine.

Infolink is on (02) 438 3033.

Softlogic Utilities

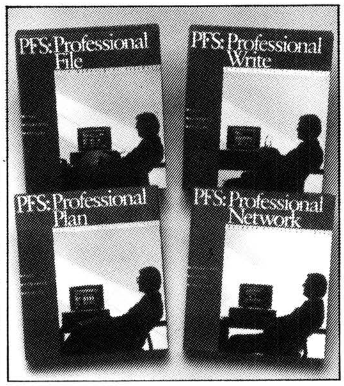
SNS Leading Edge has secured distribution rights for the Softlogic Solutions suite of utilities.

Disk Optimiser reorganises hard disks by consolidating fragmented files and grouping free spaces, thereby providing enhanced disk access speed. Cubit is a utility which performs automatic data compression on selected files.

Carousel allows up to 10 application programs to be loaded simultaneously, with applications other than the current one being paged out to disk. Double Dos is a utility which allows two applications to reside in memory and execute at the same time.

All of these utilities are priced at $99, plus tax.

SNS is on (02) 958 2399.



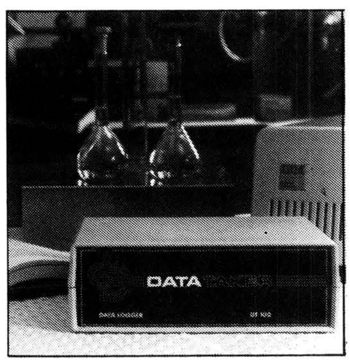
More from Software Publishing

The Software Publishing Corporation, of pfs:FILE fame, has announced a variety of new and enhanced products.

The Professional Series software products now provide network support through the IBM, Novell and 3Com networks. In an interesting marketing approach, the product may be used by only one user at a time through these networks. However, if you buy the Professional Network product, up to five users may run the Professional Series package at the same time. The network will be available in December at a cost of $845.

The Professional Series of software includes Professional File, Write and Plan. A new product, pfs:First Choice is an integrated word processor, spelling checker and filing system with reporting, spreadsheet analysis and communications. It is aimed at the first time user with extensive help and jargon-free screens. See a test elsewhere in this issue.

Peripherals



Data Logger

An Australian designed and manufactured data logger, known as the Datataker, has achieved major success in the world market. The Datataker is a programmable data acquisition device with 24k of memory, 54 channels, analogue and digital capability and a host of statistical functions. It can be interfaced to any computer with ASCII communications.

The Datataker is being used by Nasa, Bell Telephone, Volvo, General Motors, the Danish Atomic Energy Commission, and even Australian Telecom.

More information from Data Electronics Australia, (03) 221 1277.

FAX Security

Claiming that anyone with a normal tape recorder can tap into a telephone line, record a fax data stream and later play it back into their own fax machine, Visionhire has announced the availability of the first fax encryptor.

Saying that facsimile security has never really

SKAI AT-286 The Ultimate Performer

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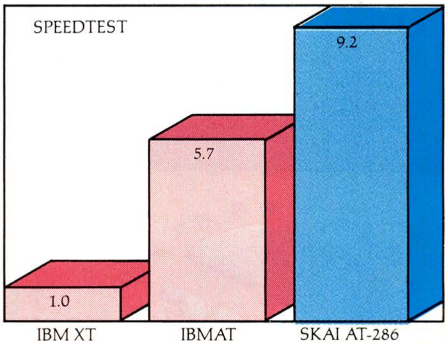
Features

Check out some of the Skai AT-286's other superior features. Like the built in 1.2M Byte floppy, Printer and serial ports, clock and hard disk drives available from 20M byte to 160M byte. Standard RAM capacity of 640-Kbytes. And you get plenty of expandability with six IBM PC/AT compatible slots and two IBM PC compatible slots.

Warranty

The Skai AT-286 is fully imported from Japan and has full Fcc-UL approval. Basically this means that the Skai is such good quality that we're willing to back it with a full 12 months warranty.

Norton SI Program V3.0



SI Test shows speed relative to the XT.

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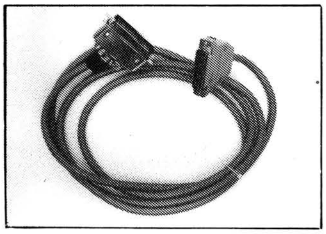
WHEN RELIABILITY IS THE DECISIVE FACTOR

been considered, Visionhire expects many banks, brokers and other organisations involved in confidential communications to make use of the encryptor. The device is already being used by Customs and the Tax Office.

More information is available on (02) 959 5600.

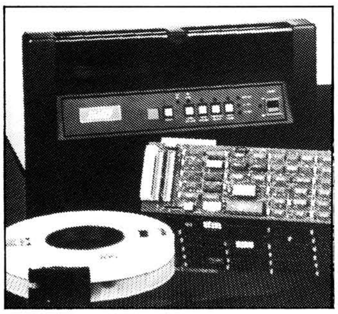


Cheaper Cables

Everyone knows how shockingly expensive computer cables are. Even the most humble printer or serial cable usually sells for between $50 and $80.

Logo Computers has introduced a new range of extremely cheap, high quality cables. Prices go as low as $6.50 for very large quantities, with one-off cables costing around $25.

Logo has cables for most parallel and serial applications, and can be reached on (02) 819 6811.

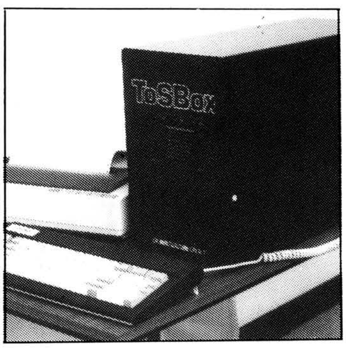


PC Tape System

Alloy Australia has announced a 9 track tape system for PCs. PC-9TRACK includes an intelligent 0.5in tape drive, interface card, cables and software. The drive itself features a built-in take-up reel and is self loading.

This device allows corporate users to more accurately and easily transfer information between personal computers and mainframes. The tape system records at 1600 BPI with a transfer speed of 700k per minute. This provides a capacity of 42Mbyte per tape.

The PC-9TRACK costs $12,750, excluding tax. Alloy is on (03) 561 4988.



Aussie ToSBox

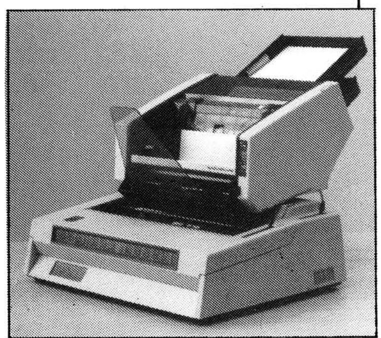
Offcom, an Australian communications company, has announced an office communications manager named ToSBox. Currently being released in Australia, and later in North America and Europe, the box is an IBM PC compatible microcomputer specifically geared to office communications.

Including a built-in display, keyboard and printer, the ToSBox is an intelligent telex machine replacement in its most lowly configuration. Using automatic queueing, retry, offline preparation and archiving, the box is claimed to reduce telex costs by 50 per cent for domestic traffic and 41 per cent for international. Offcom claims that one ToSBox provides the capacity of three normal telex machines.

Enhancements include the ability for direct office-to-office communication, LAN support for office automation and connection to IBM mainframes through an IRMA board. The system includes 256k RAM and 160k of floppy disk storage, but may be expanded with a 40Mbyte hard disk.

Offcom is on (02) 438 4199.

Printer Breeding



Spring may very well be in the air, but this photograph does not depict a new breakthrough in printer reproduction. Rather, it is a new cut sheet feeder for the IBM Quietwriter.

The Ziyad Paperjet 300A is a dual bin feeder with envelope capability. One of its most distinguishing features is the ability to remember the address printed on a letter and automatically prepare the envelope and collate the envelope with the letter. The Paperjet 300A has capacity for up to 200 sheets and 70 envelopes, and is compatible with most major word processing software.

More information is available from Viva Computer Supplies, on (02) 908 4076.

Line Analyser

Electromark has announced the availability of the OLA-7611 online protocol analyser from TOA Electronics.

The unit includes three 16 bit CPUs and a 500k floppy disk, and is capable of level 2 and level 3 interpretation at up to 64kbps full duplex in real time. The device supports RS-232C, RS-423, RS-422 and TTL interfaces and can analyse X25, HDLC, SDLC, BSC, SYNC, ASYNC and transparent protocols. Data codes may be interpreted in ASCII, JIS7, JIS8, EBCDIC or HEX.

More information is available on (02) 570 7287.

Overseas

Motorola news

A confirmed leak from Motorola has broken the news that the company will release two new processor chips next year.

FTC 3200 AT
- Intel 80286-8 CPU, 32K AMI legal BIOS.
- Socket for optional 80287 match co-processor.
- 6/8/10 MHZ by software and hardware switchable.
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- Operating system: MS DOS 3.1.

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- 512K/1MB RAM on board.
- 2 floppy drives (1.2MB or 360KB).
- Mono/Graphic/Printer or Color/Graphic/Printer
- 200W power supply.
- 20MB or 40MB hard disk can be fitted.
- Operating systems: MS DOS 3.1

FTC PORTABLE AT
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- Socket for optional 80287 match co-processor.
- 6/8/10 MHZ by software and hardware switchable.
- 1/4 MB RAM on board (41256/1MB DRAM).
- 2 floppy drives (1.2MB or 360KB).
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The 68030 is a more highly integrated version of the 68020, and is expected to include on-chip memory management and a numeric coprocessor. The 78000 processor, due for release in the first quarter of next year, is expected to be a 20 MIP RISC processor.

Optical Computers

Following on from last month's news on biological computers, staff at AT&T's Bell research labs have announced a degree of success in the development of an optical computer. Based on light instead of electricity, an optical computer is expected to run about 1000 times faster than current electronic technology. This is good news, as many manufacturers are saying that integrated circuit technology is simply not keeping up with today's demand for speed.

The breakthrough is in the development of the optical equivalent of a transistor. Called a SEED (Self Electro-optic Effect Device), the invention performs a NOR logic function on optical streams. The SEED is fabricated from gallium arsenide and aluminium gallium arsenide, which means manufacturing difficulties, and initially high prices. AT&T says it still has a long way to go, but expects to build a functional optical computer within three years.

VM/80386

Softguard Systems, the security disk people who have been badly affected by the current trend away from copy protected software, has announced its next corporate objective. Softguard plans to implement a VM/370 style operating system for the 80386. For the uninitiated, VM/370 is an operating system for large IBM mainframes which allows one machine to run several different operating systems at the same time, each thinking it has its own machine. This is similar to multi-user operating systems allowing several users to utilise the same machine, each thinking they have a dedicated computer.

Styled on VM/370, the Softguard system will allow 80386-based machines to allow several different operating systems at the same time, including Unix and MS-DOS. By supporting multiple copies of the same operating system, Softguard expects to solve the MS-DOS 640k limitation before MS-DOS version 5 arrives, as well as inherently providing multi-tasking.

Softguard expects the new operating system to be ready by mid 1987, but its success seems highly dependent upon what Microsoft can provide in MS-DOS version 5.

END

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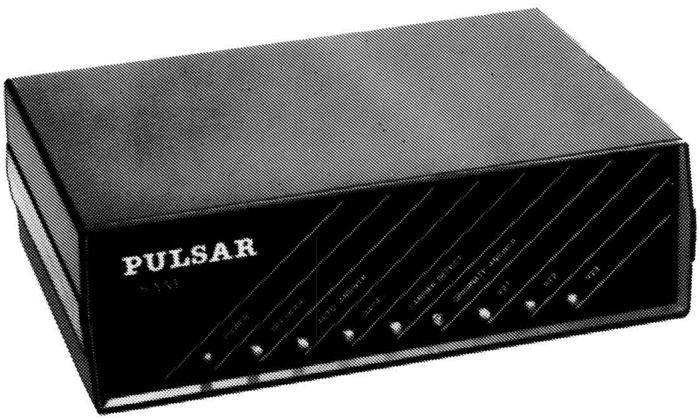

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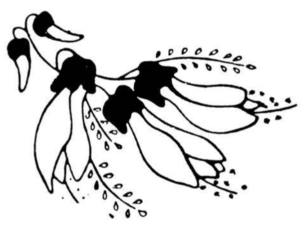

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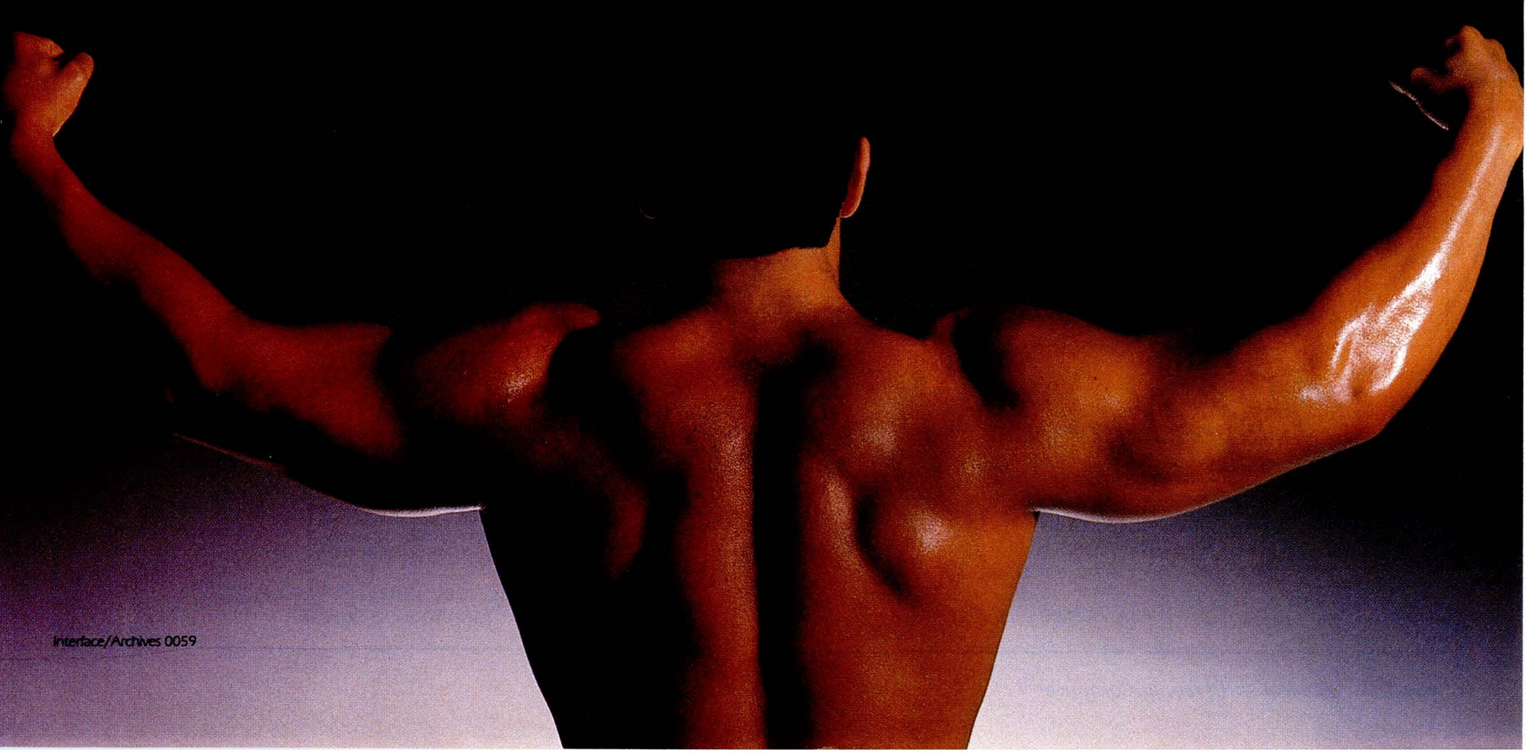
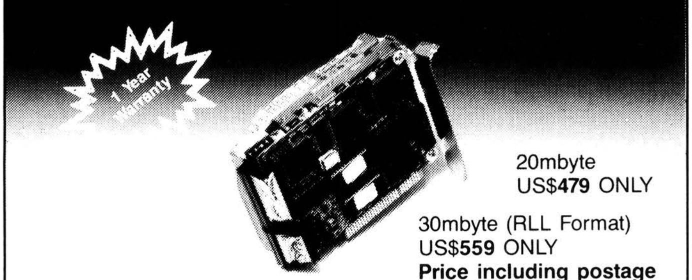


Interface/Archives 0059

HARD FILE



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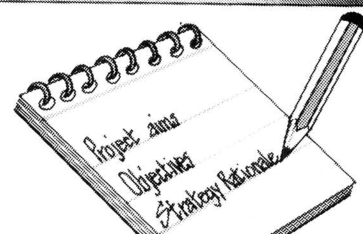

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Adplace 054

Pascal programming on the Mac is the order of the day, with a sprinkling of Basic and Sci-Fi. David Taylor reviews this month's book selection.

Pascal fruits

The Mac's too matey to program, I find. With a well-stocked hard disk itching to demonstrate this or have a go at that (or swapping the disks if you must), MacOperatives soon find that with Microsoft's Word and Chart, good old MacPaint and perhaps Think Tank, and certainly Jazz, there's not so much you can't tackle without, so to speak, having the bonnet up.

The Mac's mousey environment is, moreover, ill at ease with programming's gobbledygook. It takes all sorts, I know, but personally I'd sooner point the mouse and go than key in lines such as:

```
if NewArrival. IDNum < Start. IDNum
then
  begin
    NewArrival. Next:=Start;
    Start:=NewArrival;
    Down:= True
  end
```

Besides, Pascalling has never struck me as nearly so much fun as Niklaus Wirth made out. Anyone who names their computer language after an obscure French mathematician (Blaise Pascal) and has their sights set on the educational market should be treated with caution, I'd maintain.

Pascal has always been quite easy to master, I'll give you that: code written in blocks, full of procedures. But until now you had to sit down and plan ahead, scribble things down to compile before you could run. The release of Mac's Pascal finally brings an interactive interpreter to hand (you can see more of what goes on and interfere as programs run), but even so, Pascal scarcely has the kind of bash-on-regardless mentality which a fancy-free Mac tends to encourage.

Still, Messrs Ledgard and Singer seem smitten, and have come up with a very jolly book which aims to prod you towards Pascal problem-solving without boring you to tears learning syntax, parrot fashion. It's jolly because the lads are Sherlock Holmes fanatics and (as in their pre-Mac tome, *Elementary Pascal*) have devised little mysteries for the Great Detective and Doctor Watson to solve with the aid of an Analytical Engine (copyright Charles Babbage).

The idea is that you coo along with Watson at the force of precise, logical thinking exhibited by Holmes, not to mention the Engine. Then you think — Aha! I could do that, using MacPascal. Quite so. Elementary. It's all very silly, but at any rate differently jolly, unlike the usual run of narcoleptic Pascal primers.

In the end, you can use Pascal to draw squares or a bar chart. You can run a program which, given the properties of cigar ash, identifies the brand of cigar (very Holmesian is that) or one which will keep your golf score (which isn't). Not quite *The Speckled Band*, perhaps, but you will soon find that you've grasped the principles of the algorithm, say, or have got the hang of arrays and strings and mugged up on Pascallian syntax without hardly noticing — all very useful if you're to persist with this urge to program on a Mac.

The book is very handsomely produced, which for nearly $30 it had better be.

Title: Pascal for the Macintosh
Author: Henry Ledgard &
Andrew Singer
Publisher: Addison-Wesley
Price: $28.95

'Great!' exclaimed Pete . . .

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SAME OLD STORY

It's a boringly familiar sight. Newsagent after newsagent has sold out of *APC*.

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the first draft of your Christmas list, give this high priority. It's a ripping sci-fi yarn, action-packed adventure for computer mad youngsters — mad as you please, but intended to teach as well as entertain. It's wonderful stuff.

A sinister, blackmailing hacker snatches control of NECEN — America's North East Central Computer — and causes mischievous havoc. Hole-in-the-wall cash dispensers eat bank cards and make rude remarks to customers. Traffic lights are on the blink. Communications are cut. Then Mr President gets the message:

'I have NECEN. If you want it back, please transmit the sum of one billion dollars . . . You have 24 hours to pay me.

Respectfully, THE HARLEQUIN.'

What's to be done? Well, it's obvious, isn't it? Grab Professor Corbin and his team, shrink them down to the size of a computer bit (using lasers, how else?) and send them in to try and wrest control of the giant NECEN computer from the inside. Piece of cake, really.

En route, as you'll have guessed, we get lots of little lessons on what's what as the Prof navigates a whirling disk drive or rides an analog signal, conquers strange chips and cracks unknown code.

Will he succeed in time? I'm not going to spoil it for you, but you shouldn't need three guesses.

Utterly preposterous, then, childish and fantastic as the best of Superman. I couldn't put it down.

Title: The NECEN Voyage
Author: William S Davis
Publisher: Addison-Wesley
Price: $32.95

Basically true

Let's go already, says JCC. True Basic is really fantastic. It'll put an end to Basic dialects, plus it's automatically compiled, and, goshdarn it, a program written for your IBM PC would run just fine, without modification, on your Mac. Wow!

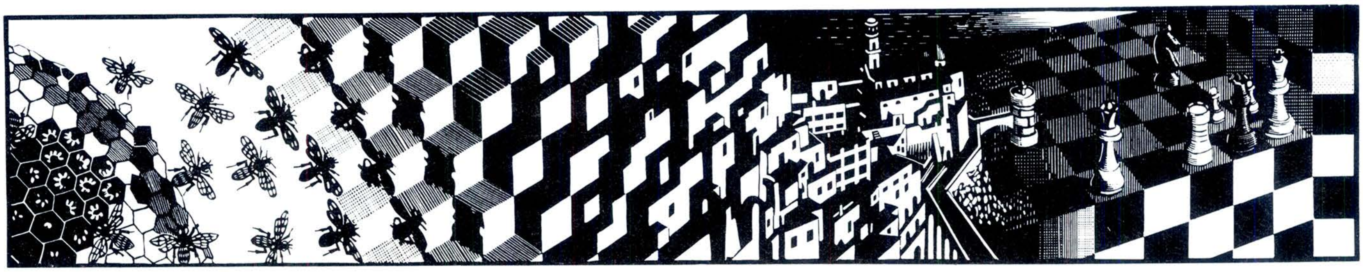
File manipulation is a snap. The graphics capability is out of this world. You want a program to figure the aim for your parabolic satellite antenna to catch the ball game on TV? No problem. Same goes for a routine to show you how the moon will look tonight. Analytical geometry and maths are a bunch of fun besides. Recursive factorial functions zap like nobody's business.

What's happening here is that y'all are 'getting your feet wet' in True Basic, testifies JCC. Maybe y'all will lose a little sleep over this, because there are a couple of hundred pages of listings to pump through here. Still, it's state-of-the-art Basic, as worked over by Basic's original inventors, John Kemeny and Thomas Kurtz. Pretty soon it'll be the world standard, JCC predicts.

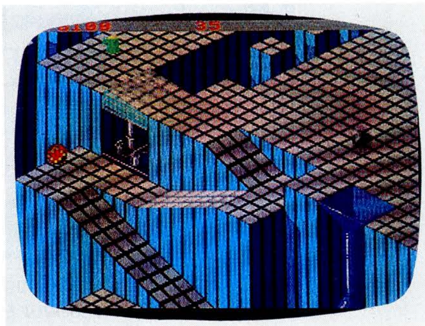
Will that many people still want to fiddle about with Basic, True or False, in a few years' time? When everyone's laid hands on a Mac or its successors? No offence, JCC. Just thought I'd ask, that's all.

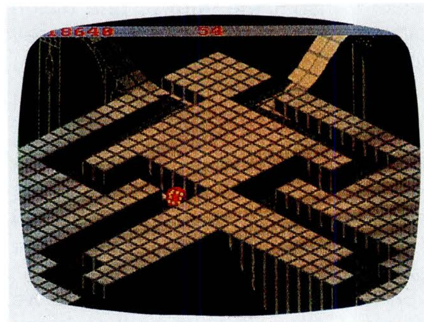
Title: True Basic: Programs
and Subroutines
Author: John Clark Craig
Publisher: TAB/Nelson
Price: $32.90

END



This month's selection of games finds Stephen Applebaum playing with marbles and saving the earth from doom and destruction.





Marble quality

Title: Marble Madness
Computer: Amiga, C-64
Supplier: ECP
Price: $89.95 (Amiga), $59.95 (C-64)

When we talk about graphics being arcade quality, we mean that they're in some way comparable to those found on machines down at your local arcade; the term isn't meant to suggest they are perfect reproductions. The screenshots above, taken from Electronic Arts incredible new acquisition for the Amiga, Marble Madness, expunge any ambiguity, however, and show the skill that has been employed in bringing an arcade classic into the home, with total fidelity.

Although not featured in 'Screenplay', there have been several earlier attempts by companies to write games for the Commodore 64, *et al*, that imitate some of Marble Madness' features. Most of them are all fairly dismal and often unplayable affairs. Now we have an accurate reproduction of the archetype of the genre that not only mirrors the original, but if anything, makes it even more playable.

Marble Madness, for those who haven't yet seen it, is a hazardous race against time, where you must guide a marble around a series of obstacle-strewn mazes inside a pre-set time limit. The coin operated Marble Madness machine employs a large tracker ball as the means of manipulating the sphere. Electronic Art's version can use a tracker ball as long as it has an Atari-standard plug, but most players will probably find the Amiga's mouse perfectly adequate.

The initial phase of Marble Madness is a simple training run along a meandering groove, ending between two fluttering flags representing goal-posts. Hardly representative of what's to come, this first stage is merely a friendly way of familiarising the player with the feel of the controls.

Marble Madness proper begins with you and the marble having to battle your way past a rogue ball, which tries its hardest to force you off the edge of the screen. If you're lucky, the ball only gets as far as pushing you onto another level, but this leaves you dazed and, at worst, prey to a bunch of even more malevolent characters.

Evading the black ball takes you down a precipitous drop which lands you on a plateau inhabited by green, voracious, hydra-like creatures. These gluttonous monsters leap into the air, land on your marble, swallow it, then pause momentarily to lick their lips in appreciation of the impromptu meal.

To avoid being consumed, you must steer your marble across a bridge that opens and closes on superbly drawn, fully-animated hydraulic jacks. This leads to a conduit running down onto a ledge that twists and turns, threatening to send you to your death at the slightest hint of a mistake. Navigate this section successfully and you'll come to another pipe which leads to the relative safety of an ice field, the last 'hazard' before your goal.

As the game proceeds, the number of hazards increases in both number and severity. At one point, giant vacuum cleaner-type machines appear and try to suck you up into oblivion, while tiny rubber mallets emerge from underground, crushing your marble to a pulp. There are even giant rods which toss your marble into the air, sending it plummeting to its death.

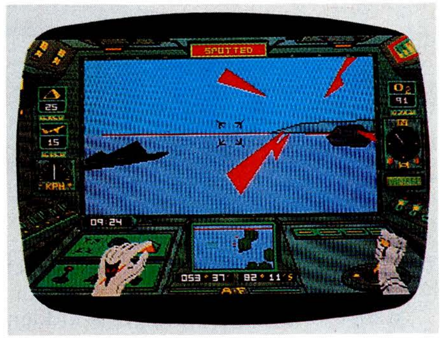
Points are scored by completing a phase within the time set at the start, as well as reaching specific points on a course and eluding the various things lurking there. Bonuses can be picked up by having time left at the end.

Much like Arcticfox, also reviewed here, Marble Madness includes some superb sound effects. The music, a farrago of delightful little ditties, is an exact simulation of that found on the arcade original. Even the vicious vacuums make a disturbing roar as they appear, seemingly from nowhere.

One of the most amusing features of Electronic Art's Marble Madness is the inclusion of all the original 'bugs', or rather, idiosyncracies. The most obvious of these is the game's collision detection. For instance, if a ball falls off a surface and touches a wall as it drops, a brush appears in mid-air to sweep up the

pieces. Apart from this rather nice effect, there aren't any other quirks poignant enough to warrant a mention.

Marble Madness is a game with balls. If ever there were a game that could be accurately dubbed arcade quality, this is it.



Fire and ice

Title: Arcticfox
Computer: Commodore Amiga
Supplier: ECP
Price: $89.95

Beware — the enemy is among us! Somewhere in the icy wastes of Antarctica, an alien cadre is busily preparing the way for an Armada from its home planet, STV-7X, by building towering edifices to convert the composition of the Earth's atmosphere into a form more suited to its physiological make-up.

With each passing day, the alien's grip on the Earth tightens, pulling Mankind ever nearer to the abyss. Oblivion is not far off, unless something can be done to breach the extensive forcefield protecting the creatures and destroy the heart of their operation — the Main Fort.

And so to Arcticfox, a supertank, built courtesy of General Polemics. In your capable hands this formidable piece of hardware could prove to be the alien's nemesis. If it doesn't, the rout of civilisation will be quick to follow.

When positioned in the driver's seat inside the Arcticfox, you can look out through a large window into the almost extraterrestrial Antarctic landscape; below, a small radar-cum-aft-view offers another perspective. Located along the bottom of the display is a control panel.

To the right, a hand grips a joystick, simulating the movement of your hand as you steer the Arcticfox to its quarry; on the left are six buttons, over which is poised the computerised driver's other hand.

The six buttons relate to six keys laid out in a similar form on the Amiga's keyboard. These correspond to: cannon inclination; aft view selector; mine release; relative reverse; guided missiles; and dig-in. Most of these devices are self-explanatory, but it's worth looking at some *in extenso* by dint of the work that has gone into the detail of their operation and effect.

When a guided missile is launched, it can be steered toward its target from the safety of the Arcticfox. If you're feeling particularly sadistic, however, you can become the missile itself, putting yourself in the position of a pseudo-Kamikazi pilot. In becoming the missile, you temporarily gain the ability to fly, and can engage enemy aircraft in a deadly game of cat and mouse.

Pressing the 'dig-in' function when in snow literally buries the Arcticfox, protecting it from almost any enemy onslaught. Going to ground also provides protection during one of the many electric storms that become increasingly more frequent as you near the Main Fort, caused by the oxygen in the atmosphere being replaced by a volatile mixture of deadly gases.

Accompanying the master controls are various dials and digital counters which provide vital data such as the number of guided missiles you have left, the number of mines onboard, the tank's speed, your direction, the percentage of oxygen in the air, and a constantly updated damage report.

Before setting out on a mission, the game's one and only menu lets you identify the various kinds of enemy craft — an idea dreamed up by an Electronic Arts games tester who didn't survive long enough to see his executioner, no doubt. Beginners can, and should, start on the easy level, as this has a smaller number of alien craft around the Main Fort. If you're a glutton for punishment you can move straight on to the advanced level where, unless you employ a good stratagem, you'll be wiped out before getting anywhere near the alien HQ.

Dotted about the landscape are Communications Forts that the aliens have deployed to keep them posted as to your whereabouts. These, and things called Recon Sleds and Recon Flyers, can reveal your position to other craft in the vicinity, so should be destroyed when first spotted.

At the end of a game (which is to say, when you've been destroyed) you're presented with a tactical rating and the manner in which you met your death. Apart from being ripped apart by enemy gunfire, which is an obvious way to go, you can meet the man with the scythe by driving the Arcticfox into a crevass!

If you're one of the few people who currently owns an Amiga, you'll no doubt be aware of its amazing stereo sound. Should you not have bought any games for it, however, you probably won't realise just how good it is. Play Arcticfox and you'll be enthralled by the realistic trundling of the tank's caterpillar tracks, and the pleasing crunching sound made when passing over the wreckage of an alien vehicle. Missiles, too, make an impressive whooshing noise, while forked lightning strikes the ground with a veritable crack.

Arcticfox is also impressive graphically, using filled Battle Zone/Elite-type figures. Unfortunately the speed of movement is slow, but because everything moves at around the same pace, missiles included, the game is just as difficult as if everything were moving at full tilt.

It has taken a long time for the *APC* office to be graced with an Amiga, but if all the software is of the same high standard as Arcticfox, it has been well worth the wait. Although a little pricey, Arcticfox justifies every last cent, and the enjoyment it gives will make you forget about the hole it has left in your pocket.

END

More BBS wordplay

Steve Withers presents his monthly round-up of bulletin board news.

Abbreviations

Continuing with last month's theme of wordplay and non-verbal messages, I recently encountered a couple of new examples. I suspect the first comes from someone with a mathematical inclination:

tanh(q) in antic................ipation

while I can only assume the second is supposed to signify mild confusion:

#—

Overseas news

Sysops in the UK recently formed a group called the Bulletin Board Operators' Association, with the following aims:

1) to encourage public electronic communication of data;
2) to promote and co-ordinate individual bulletin boards;
3) to establish and maintain standards and practices by means of a code of conduct.

It seems that there were two main reasons for the formation of this organisation. Firstly, it will provide a united front for dealings with British Telecom. A fairly popular BBS in the UK generates the equivalent of $500-$1000 in revenue for British Telecom (even local calls are timed) and the sysops feel that some concessions are due to them. Secondly, there are fears that recent publicity about hackers' BBSs could lead to a clamp-down affecting legitimate systems as well as those promoting illegal behaviour.

System news

FidoNet is going from strength to strength, with more than a dozen systems in the eastern states. I've heard from someone in Perth who plans to join the network, but (so far as I know) all the existing systems are in New South Wales, Victoria, and the ACT.

Mark Little writes that his system — one of the few in the Northern Territory — is back in business (whoops, I hadn't heard that it had gone off-line!). He says that the most significant feature of the new software is that it provides a screen editor with WordStar-like commands. Of course, the system needs to know what type of terminal you are using (or emulating) to achieve this, but the 50-odd definitions should cater for most users. The program's size is a mere 16k, but that's the result of writing in Z80 assembler instead of making do with the bloated output from a compiler. Mark's system is also one of the few that can be accessed by packet radio as well as telephone.

New systems

NSW

Aus Talc (02) 438 3479. 24 hours daily. V21, V22. A FidoNet system.

Fido Australia (02) 959 3712. 24 hours daily. V21, V22, V22bis. A FidoNet system. (Previously listed as Ausnet).

Scitec Olympic (02) 427 1212. 24 hours daily. V21, V22, V22bis. A FidoNet system.

Tachyonics (02) 438 2682. 10pm-6am daily. V21, V22. A FidoNet system.

ACT

Canberra PCUG (062) 58 9967. 24 hours daily. V21, V22, V22bis. A FidoNet system.

Victoria

Sam's (03) 563 1117. A FidoNet system.

Updates

NSW

Freecom Off-line.

Omega Line (02) 457 8281. P. Geoff Arthur. 24 hours daily. V21, V22, V23. A FidoNet system.

Realtors (02) 387 5335. 24 hours daily. V21, V22, Bell 103 & 212. A FidoNet System.

Sentry (02) 428 4687. MV. Trev Roydhouse. 9pm-6am weekdays. 8pm-6am weekends. A FidoNet system.

Sorceror Users Group (02) 626 8020. 24 hours daily.

Victoria

The Real Connection (03) 288 0331. Carla Miller. 24 hours daily. A FidoNet system.

NT

Telepack (089) 52 8852. Mark Little. 24 hours daily. V21, packet radio. Previously listed as Red Centre.

The material in this column is presented in good faith, but as it is collated from material porovided by readers, *APC* cannot take responsibility for its accuracy. New information and corrections are always welcome (but please mention whether or not you can vouch for the accuracy of the material you provide), and should be sent to Steve Withers at one of the following addresses: C/- Computer Publications, 77 Glenhuntly Road, Elwood, Vic 3184. Viatel 063000030, Teledata 11UNR-WITHERS.

Acknowledgements will normally be made through this column. You may also like to send a copy of the information to the Australian PAMS Coordinator at one of these addresses: PO Box E41, Emerton NSW 2770; ACSnet prophet@runx; Teledata prophet; Prophet Bulletin Board (02) 628 7030.

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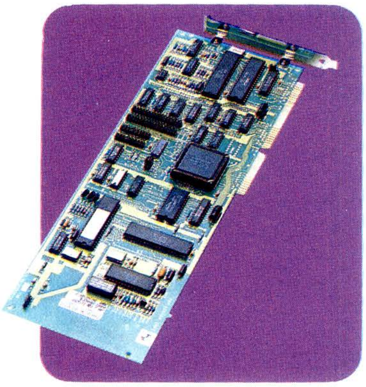
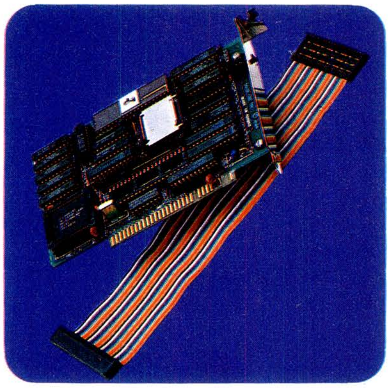
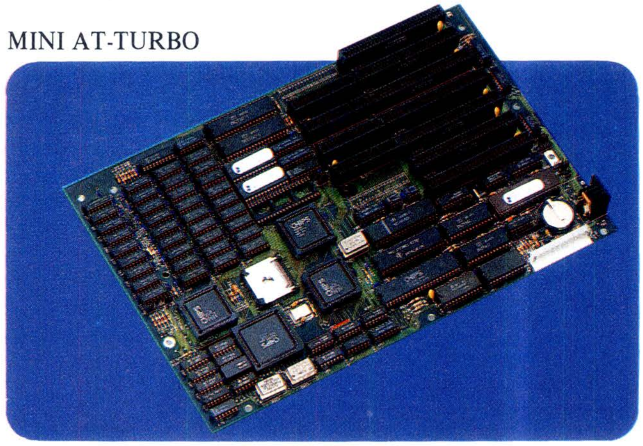


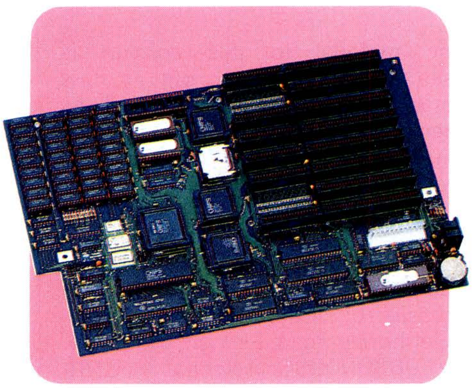
SPEED CARD



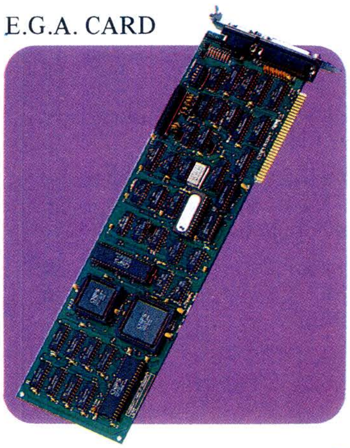
MINI AT-TURBO



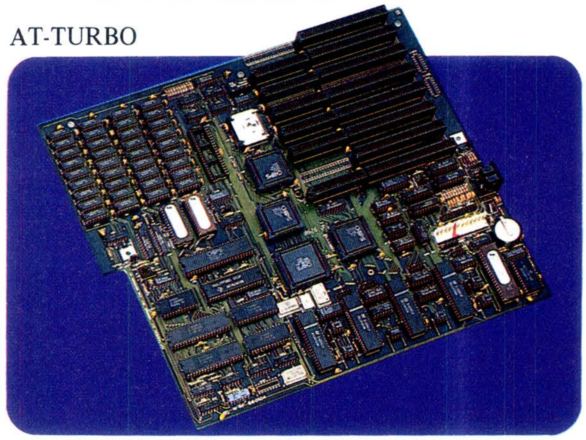
STREAMLINED AT-TURBO



E.G.A. CARD



AT-TURBO



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In the nick of time

It's seven years since the original APC Benchmarks were devised, so we felt it was high time new Benchmarks were created to accommodate modern trends in hardware and programming languages. Nick Walker presents the definitive, but very flexible, APC Benchmarks.

Ever since *APC* started back in May 1980, we've been testing machines with a set of Basic programs designed to test the speed at which certain routines are carried out. The original Basic Benchmarks, which were designed by the defunct US magazine *Kilobaud*, were created to provide an objective measure to evaluate the performance of the system and, more importantly, to provide comparison with other similar machines.

The original *APC* Benchmarks were created at a time when a good home computer contained 8k of RAM, 8k of ROM, a cassette tape interface and, if you were extremely lucky, some primitive form of screen output. The only common thing you could rely on was that practically all the machines had a version of Basic on tape or in ROM. It isn't surprising, therefore, that the Benchmarks were written in Basic and made no attempt to access any I/O.

It's a credit to these original *APC* Benchmarks that they have survived eight years of the micro business. It's rare even now that a machine doesn't have a version of Basic available, though it's certainly not unknown. However, it's true that these Benchmarks are considerably less relevant today than they were. The machines tested now spend most of their time running applications that typically use a disk drive interactively, and address both the text and graphic modes of a screen. It's rare that any of these applications are written in Basic.

The original Benchmarks have provided a standard for eight years, and a vast amount of data is now available. The time has come to create new Benchmarks that are more relevant to the operations a micro might spend its life performing.

Design criteria

One of the reasons for the success of the original *APC* Benchmarks was that they were short and understandable. Users of

```
intmath:
declare three integer variables X, Y and I
  assign X equal to 0 and Y equal to 9
  write 'Start' to screen
  repeat 1000 times using I as the loop variable:
    assign X equal to X+Y-Y*Y/Y (use integer divide if provided)
  write 'Finish' and X to screen (final X value should be 0)
realmath:
  declare two real variables X and Y
  declare an integer variable I
  assign X equal to 0 and Y equal to 9.9
  write 'Start' to screen
  repeat 1000 times using I as the loop variable:
    assign X equal to X+Y-Y*Y/Y
  write 'Finish' and X to screen (final X value should be 0)
triglog:
  declare two real variables X and Y
  declare an integer variable I
  write 'Start' to screen
  assign X equal to 0 and Y equal to 9.9
  repeat 1000 times using I as the loop variable:
    assign X equal to Cos(Sin(ArcTan(Log(Y))))
  write 'Finish' and X to screen (final X value should be 1000)
textscrn:
  declare an integer variable I
  write 'Start' to screen
  repeat 1000 times using I as the loop variable:
    write '1234567890qwertyuiop' and I to screen
  write 'Finish' to screen
grafscrn:
  declare integer variable I and J
  write 'Start' to screen
  repeat 100 times using X as the loop variable:
    repeat 100 times using Y as the loop variable:
      plot pixel at screen position (X,Y)
  print 'Finish' to screen
store:
  declare an integer variable I
  write 'Start' to screen
  create a disk file 'Test'
  open 'Test' for input
  repeat 1000 times using I as the loop variable:
    write the record '1234567890qwertyuiop' to 'Test'
  close 'Test'
  delete 'Test'
  write 'Finish' to screen
```

Fig 1 English description of new Benchmarks

any machine, even if it weren't Bench-tested in *APC,* could type in the Benchmarks and get a measure of how fast the machine is compared to its rivals. I recently made a call for suggestions as to what form the new Benchmarks should take. Among the letters received were a number calling for a 'complete system test' consisting of a vast amount of compiled code which would extensively test the whole system. While I agree that such a test would give a more accurate basis for comparison, it would severely limit the number of users able to run the test. Therefore, the new Benchmarks are of a similar length to the old.

The old Benchmark timings are usually ascribed to a particular machine when it would be more correct to refer them to a machine and dialect of Basic used. For example, an IBM PC running the latest version of GWBasic is noticeably quicker than an IBM PC running BasicA, which explains why all the IBM clones are quicker than the original.

To overcome this, the new Benchmarks have been specified in a language-independent form. This makes them capable of comparing different versions of the same language in a language review, or capable of testing the speed of a machine when compared with a rival machine running the same language.

Having decided that the Benchmarks should be short and language-independent, by far the most difficult decision was determining which features the Benchmarks should test. After much consideration, the following were chosen:

(1) Two separate Benchmarks to test integer and real arithmetic. Integer arithmetic gives a good indication of the general processor speed, whereas real arithmetic speed depends on the quality of algorithms in the software, unless a floating-point chip is used.

(2) A separate Benchmark to test logarithmic and trigonometric functions, as these are primarily of interest to scientific users and certain heavy number crunching business applications.

(3) Two separate Benchmarks to test the speed of text and graphics screen I/O. The graphics screen I/O test should use nothing more complex than Plot (x,y) to enable it to be run on as many machines and languages as possible.

(4) Some test of disk speed was required; this proved the most difficult to design as disk speed is affected by so many factors. For example, an old hard disk will perform more slowly than a new one, due to file fragmentation. The Benchmark we chose does not attempt to overcome these problems, but it's simple and our subsequent experiments proved it to be a reasonable index when compared with far more complex disk test procedures. Most users don't start with fresh disks every morning, and the aim of these Benchmarks is to reflect real world usage, albeit at the cost of strict scientific comparability.

The new Benchmarks

There are six Benchmarks:

- IntMath: tests integer mathematics speed
- RealMath: tests real mathematics speed
- TrigLog: tests speed of trigonometric and logarithmic functions
- TextScrn: tests screen I/O with a text screen
- GrafScrn: tests screen I/O with a graphics screen
- Store: tests disk I/O

When translating the Benchmarks into a different language or dialect, try to produce code that closely matches the structure of the English description. Don't use quick and dirty short-cuts to gain a few tenths of a second, as this is just misleading. A good rule of thumb is that for every line of the English description, there should be one or more corresponding lines in the code. If you can't relate each line on this one-to-one or one-to-many basis, take a second look at your source code.

'A good rule of thumb is that for every line of the English description, there should be one or more corresponding lines in the code.'

It's quite possible that some languages will be unable to run some of the Benchmarks. Don't resort to convoluted tricks in this case; a blank conveys as much information as a timing, namely that this language is a poor choice for the task.

Finally, there will be no average figure. The average figure of the original Benchmarks was totally meaningless and the most abused by manufacturers. With only six Benchmarks it isn't difficult to assimilate all the necessary information, if that's what you want to do.

The advantage of the new Benchmarks is their flexibility. They can compare different machines running the same language; different languages on the same machine; and the same language on the same machine in different environments. For example, you could run TextScrn on a GEM-based computer in different sized windows, or with different numbers of windows open.

Conclusion

To make these Benchmarks work, we need to gather as much information as possible about current hardware and software. In the coming months, *APC* will test as many machines as possible and publish the results periodically. However, there's no way that we can cover all the machines and all the languages, which is where you can help. If you run these new Benchmarks on your machine, please send us the results, complete with source code, and help us make them as successful as the original Benchmarks.

I'd like to think of the Benchmarks as frozen, but if you have any serious objection to them as presented in this article, please let me know. Next month, we'll turn our attention to the problem of devising a scheme for the compatibility of IBM PC clones.

END

	IntMath	RealMath	TrigLog	TextScrn	GrafScrn	Store
IBM PC running Turbo Pascal	0.18	4.0	56.4	76.4	5.0	4.9
IBM PC running BasicA	6.2	8.2	47.0	100.0	49.0	17.2
IBM PC running PC Forth	0.3	—	—	67.0	2.4	1.9
Atari ST running ST Basic	1.5	1.9	7.9	44.8	22.7	9.9
Atari ST running Megamax C	0.16	1.1	7.9	39.6	7.7	7.1
Commodore Amiga Basic	1.7	2.7	6.7	150.3	25.0	32.7

Notes: The IBM PC used an external Ampex hard disk with Xebec controller; both the Amiga and the ST used the internal 1 Mbyte floppy

Fig 2 Table of results

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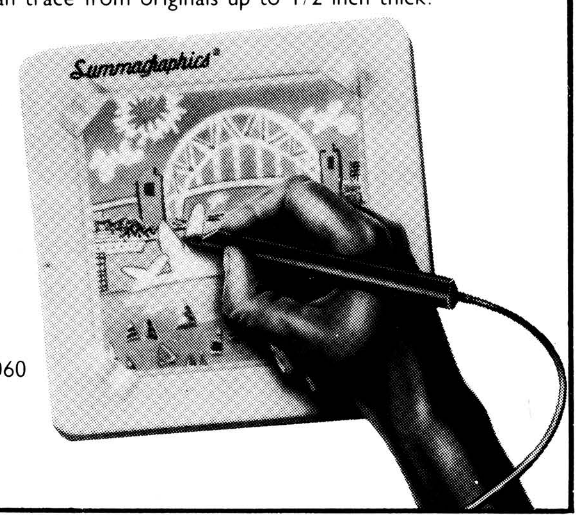

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David Barrow presents more documented machine code routines and useful information for the assembly language programmer. If you have a good routine, an improvement or conversion of one already printed, or just a helpful programming hint, then send it in and share it with other programmers. Subroutines for any of the popular processors and computers are welcome but please include full documentation. All published code will be paid for. Send your contributions to Subset, APC, 2nd Floor, 215 Clarence Street, Sydney 2000

DATASHEET FORMAT

You will notice a few changes in the format of SubSet datasheets this month.

The main improvement is that the line width has been increased from 64 to 72 characters, allowing for labels of up to eight characters, and the longer operands and object codes of 68000 and 8086.

The wider format also gives scope for more descriptive section headings in the documentation — 68000 programmers will know whether stack usage is in bytes or words, and top-flight Z80 coders like John Hardman will now cease to confuse clock cycles (that is, time states) with machine cycles.

One change that is long overdue — according to an erstwhile frequent contributor who wishes to remain anonymous — is the standardisation of the Action section. This is now renamed 'Structure' and gives (where possible) a language-independent formal description. Braces enclose iterative clauses (FOR, UNTIL, WHILE) and square brackets enclose the selective process (IF) with the vertical bar separating 'then' and 'else'.

6809 BYTE QUEUES

QPUT and QTAK (datasheet one) from Stephen Smith are straightforward queue manipulation routines.

Queues are first-in, first-out (FIFO) data structures, and need pointers to both the next write and next read locations. Data is inserted at the queue's tail and read from the head of the queue. This has the unseemly effect of the head chasing its tail through all memory, unless a control system is imposed to loop both head and tail back to the start of queue memory when the allotted maximum extent is reached. Such control causes the effect known as 'wrap-around' where the lowest address byte is logically consecutive to the highest address byte — an effect that occurs automatically on 256-byte chunks of memory situated on a single page of memory and indexed by a single byte. Since the size of queues accessed by QPUT and QTAK does not necessarily correspond to this fortuitous circumstance, the head or tail index needs to be adjusted modulo QMAX whenever a queue read or write occurs.

The routines work only on byte data with maximum queue extent of 255 bytes, but the method is applicable to larger queues. This would entail using 16-bit indices and, perhaps, utilising the Y register as a pointer for transferring data strings between the queue and some other area of memory.

DATASHEET 1

```
;=======================================================================
;CALL: QPUT       Write one byte to a wraparound queue structure,
;                 adjusting pointers, or return queue full information.
;CALL: QTAK       Read one byte from a wraparound queue structure,
;                 adjusting pointers, or return queue empty information.
;=======================================================================
;CONCEPT          (System & language independent description)
;Data Structure   Wraparound queue.     Element size: 1 byte.
;                   Header information: (1) Number of free bytes.
;                                       (2) Tail index (write index).
;                                       (3) Head index (read index).
;                   Other information:  Maximum queue size.
;Prog. Structure  (For write, with read alternatives in parentheses.)
;                 IF queue is full (empty)
;                 [
;                   set full (empty) flag.
;                 :
;                   IF tail (head) index > maximum queue extent
;                   [
;                     reset tail (head) index to lowest queue address.
;                   :
;                   ]
;                   write (read) indexed element.
;                   increment tail (head) index.
;                   decrement (increment) free byte count.
;                   clear full (empty) flag.
;                 ]
;-----------------------------------------------------------------------
;SYSTEM           (System implementation requirements)
;Processor        6809
;Hardware need    Queue in RAM.
;Software need    None.
;-----------------------------------------------------------------------
;PROGRAM          (Specific coding and operation details)
;Input state      QPUT: X addresses queue header information.
;                       A contains byte to be written to queue.
;                 QTAK: X addresses queue header information.
;                 Queue must be initialised or active.
;                 Queue format: byte 0,X: no. of free bytes.
;                                    1,X: tail index (1 to QMAX).
;                                    2,X: head index (1 to QMAX).
;                          3,X to QMAX+2,X: queue data bytes.
;Output state     QPUT: Z=0:  Byte written. Queue indices updated.
;                             X addresses written byte.
;                             B = queue index to written byte.
;                             A is unchanged.
;                       Z=1:  Queue full. A, B, X & queue unchanged.
;                 QTAK: Z=0:  A = byte read. Queue indices updated.
;                             X addresses read byte.
;                             B = queue index to read byte.
;                       Z=1:  Queue empty. A, B, X & queue unchanged.
;Misuse Errors    None (except uninitialised queue structure).
;Register need    A B X CC
;Location need    Not specific.
;Program Bytes    56 (QPUT: 27: QTAK: 29).
;Stack Bytes      None.
;Clock Cycles     QPUT: 57 (+7 if wraparound occurs). 12 if queue full.
;                 QTAK: 59 (+7 if wraparound occurs). 14 if queue empty.
;-----------------------------------------------------------------------
;SUBSET CLASS     (Environmental hazard guide)
;-*****   2       Discreet:  NO    Interruptable: YES   Promable: YES
;                 Reentrant: YES   Relocatable:   YES   Robust:   YES
;=======================================================================
;
QMAX     EQU   nn               ;Single byte maximum queue size.
;
QPUT     LDB   ,X               ;Test number of free bytes      E684
         BEQ   QPUTEND          ;and exit, Z=1, if none free.   27    16
```

```
        LDB    #QMAX       ;Else get max queue bytes        C6     nn
        CMPB   1,X         ;compare with tail index,        E101
        BNE    QPUTTAIL    ;skip if not at max extent,      26     02
        CLR    1,X         ;else wraparound to start.       6F01
;
QPUTTAIL INC   1,X         ;Add 1 to tail index.            6C01
        LDB    1,X         ;Get tail index and re-index     E601
        DECB               ;pre-update position.            5A
        DEC    ,X          ;Subtract 1 from free bytes.     6A84
        LEAX   3,X         ;Address queue data lowest byte  3003
        ABX                ;add index to tail and           3A
        STA    ,X          ;write byte to queue tail.       A784
        ANDCC  #$FB        ;Clear Z to show write success.  1C     FB
;
QPUTEND RTS                ;Exit QPUT.                      39
;
;-------------------------------------------------------------
;
QTAK    LDB    ,X          ;Test number of free bytes       E684
        CMPB   #QMAX       ;against maximum number          C1     nn
        BEQ    QTAKEND     ;and exit, Z=1, if all free.     27     16
        LDB    #QMAX       ;Else get max queue bytes        C6     nn
        CMPB   2,X         ;compare with head index,        E102
        BNE    QTAKHEAD    ;skip if not at max extent,      26     02
        CLR    2,X         ;else wraparound to start.       6F02
;
QTAKHEAD INC   2,X         ;Add 1 to head index.            6C02
        LDB    2,X         ;Get head index and re-index     E602
        DECB               ;pre-update position.            5A
        INC    ,X          ;Add 1 to free bytes.            6C84
        LEAX   3,X         ;Address queue data lowest byte  3003
        ABX                ;add index to head and           3A
        LDA    ,X          ;read byte from queue head.      A684
        ANDCC  #$FB        ;Clear Z to show read success.   1C     FB
;
QTAKEND RTS                ;Exit QTAK.                      39
```

68000 CHARACTER ROTATION

CHROT68K (datasheet two) from Roger Thomas rotates an eight by eight bit-matrix (eight consecutive bytes) anticlockwise through 90°. The matrix is assumed to represent a character dot pattern, so the routine would be useful in many graphics applications.

At 74 bytes the routine seems large — although, taking only 2536 clock cycles, it's much quicker than the 38-byte 68000 character transposition given in September. Nevertheless, it would still take some two-thirds of a second to rotate all monochromatic characters on an 80-character by 25-line display with a CPU running at 8MHz. With slower clock speeds, larger character matrices and colour displays, this form of character rotation could be unacceptably slow for changes to more than a handful of characters.

One problem with the 68000 is that shifts and rotations of memory can only be carried out on word-length data. Roger's solution is to transfer the eight matrix bytes from source to stack workspace through data registers using the 'MOVEP' instruction: 'MOVEP.L Dn,$00(A7)' writes the four bytes of register not to four consecutive bytes, but to four consecutive *words* above the User Stack Pointer A7.

CHROT68K uses the USP dynamically to address each byte for rotation, and is above the stack workspace on exit from SRCELOOP. Consequently, it should not be used in any environment where interrupts use the USP, since some or all of the source data will be overwritten.

DATASHEET 2

```
;-------------------------------------------------------------
;CALL: CHROT68K   Rotate an 8-bit by 8-bit character matrix, stored
;                 as eight contiguous bytes, by 90° anticlockwise.
;-------------------------------------------------------------
;CONCEPT          (System & language independent description)
;Structure        move 8-byte source to workspace.
;                 destination = source.
```

SUBSET

```
;                FOR each destination byte (7 to 0)
;                {
;                  FOR each workspace byte (0 to 7).
;                  {
;                    shift left workspace byte.
;                    rotate left destination byte.
;                  }
;                }
;
;SYSTEM          (System implementation requirements)
;Processor       68000 series.
;Hardware need   8 bytes matrix RAM.
;Software need   None.
;
;PROGRAM         (Specific coding and operation details)
;Input state     A0 addresses 8-byte source matrix (lowest address).
;Output state    Matrix rotated 90° anticlockwise.
;                CCR changed. All other registers unchanged.
;Misuse Errors   Interrupt could cause overwrite of stack workspace.
;Register need   A0 CCR
;Location need   Not specific.
;Program Bytes   74
;Stack Bytes     (A7): 32
;Clock Cycles    2536 (68000 timing).
;
;SUBSET CLASS    (Environmental hazard guide)
;--*-*-    2     Discreet:  NO      Interruptable: NO       Promable: YES
;                Reentrant: NO      Relocatable:   YES      Robust:   NO
;

        MOVE.L   (A0)+,D0         ;Get source bytes 0-3        2018
        MOVE.L   (A0)+,D1         ;and source bytes 4-7        2218
        SUBA.L   #16,A7           ;Clear 8-word stack          9FFC 0000 0010
        MOVEP.L  D0,$00(A7)       ;workspace & store the       01CF 0000
        ADDA.L   #8,A7            ;8 bytes to hi-order         DFFC 0000 0008
        MOVEP.L  D1,$00(A7)       ;butes of 8 consecutive      03CF 0000
        SUBA.L   #8,A7            ;words above USP.            9FFC 0000 0008
        MOVE.W   #7,D0            ;8 result bytes count.       303C 0007
;
DESTLOOP MOVE.W  #7,D2            ;8 source bytes count.       343C 0007
;
SRCELOOP ROXL    (A7)+            ;Left shift (word) next      E5DF
        ROXL.B   #1,D1            ;position source bits        E311
        DBRA     D2,SRCELOOP      ;via X to D1(7-0).           51CA FFFA
;
        SUBA.L   #16,A7           ;Reset USP to source.        9FFC 0000 0010
        MOVE.B   D1,-(A0)         ;Store result byte of 8      1101
        DBRA     D0,DESTLOOP      ;same place source bits.     51C8 FFEA
;
        ADDA.L   #16,A7           ;Tidy USP workspace.         DFFC 0000 0010
        MOVEM.L  (A7)+,D0-D2/A0   ;restore working regs.       4CDF 0107
        RTS                       ;Exit, matrix rotated.       4E75
```

6809 CHARACTER ROTATION

CHROT689 (datasheet three) is yet another character rotation for 6809-based machines. The last one (CHROT in March) performed an anticlockwise rotation of 90° in 48 bytes and 1544 clock cycles. CHROT689, from Roger Fine, does a clockwise rotation in only 36 bytes and 971 cycles.

Roger achieves the extra speed by cutting the result loop iterations down from eight to four and computing two result bytes in each pass. This ingenious method utilises two inner loops which remove all need for resetting the source pointer: the first loop auto-increments the pointer to the end of matrix RAM and the second auto-decrements it back to the start.

DATASHEET 3

```
;
;CALL: CHROT689  Rotate an 8-bit by 8-bit character matrix, stored
;                as eight contiguous bytes, by 90° clockwise.
;
;CONCEPT         (System & language independent description)
;Structure       FOR each result word (3 to 0)
;                {
;                  FOR each source byte (0 to 7)
;                  {
;                    shift right source byte.
;                    rotate right result word lo-byte.
```

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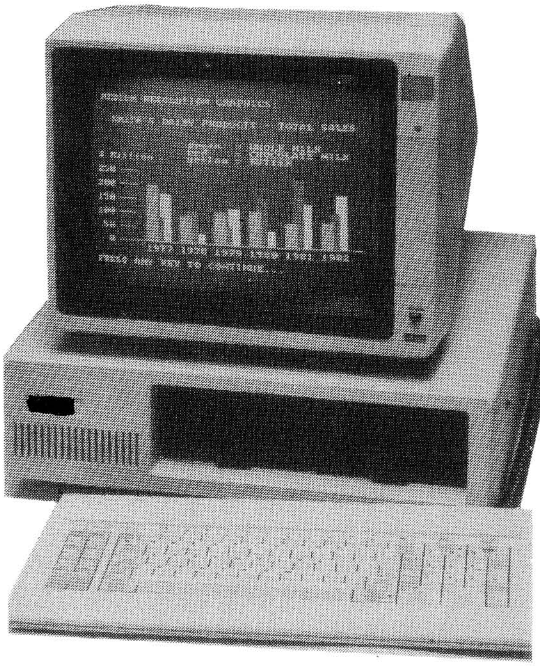
SUBSET

```
;                      }
;                      FOR each source byte (7 to 0)
;                      {
;                        shift right source byte.
;                        rotate left result word hi-byte.
;                      }
;                      move 4-word result to source.
;                    }
;
;SYSTEM              (System implementation requirements)
;Processor           6809
;Hardware need       8 bytes matrix RAM.
;Software need       None.
;
;PROGRAM             (Specific coding and operation details)
;Input state         U addresses 8-byte source matrix (lowest address).
;Output state        Matrix rotated 90° clockwise.
;                    CC changed. All other registers unchanged.
;Misuse Errors       None.
;Register need       U CC
;Location need       Not specific.
;Program Bytes       36
;Stack Bytes         (S): 14
;Clock Cycles        971
;
;SUBSET CLASS        (Environmental hazard guide)
;-*****   2          Discreet:  NO      Interruptable: YES    Promable: YES
;                    Reentrant: YES     Relocatable:   YES    Robust:   YES
;
;
CHROT689 PSHS  X,Y,D      ;Save working registers.           3436
         LDX   #$FFFC     ;Set 4-word result count.          8E   FFFC
;
WORDLOOP LDD   #$0180     ;Set terminator bits in A & B.     CC   0180
;
LOWLOOP  LSR   ,U+        ;Moving up through source, get     64C0
         RORB             ;next even-number bit from each    56
         BCC   LOWLOOP    ;byte to B. Loop till terminator.  24   FB
;
HIGHLOOP LSR   ,-U        ;Moving down through source, get   64C2
         ROLA             ;next odd-number bit from each     49
         BCC   HIGHLOOP   ;byte to A. Loop till terminator.  24   FB
;
         PSHS  D          ;Save result word to stack.        3406
         LEAX  1,X        ;repeat for 4 result words.        3001
         BNE   WORDLOOP   ;                                  26   ED
;
         LEAU  6,U        ;Set U-stack to receive lowest     3346
         PULS  X,Y,D      ;3 words and transfer back to      3536
         PSHU  X,Y,D      ;matrix RAM using pull/push.       3636
         PULS  D          ;Get highest result word and       3506
         STD   6,U        ;store back to matrix RAM.         ED46
         PULS  X,Y,D,PC   ;Restore registers & exit.         35B6
```

'No wonder the magazine gave it a great write-up — it keeps taking out subscriptions and it won't stop!'



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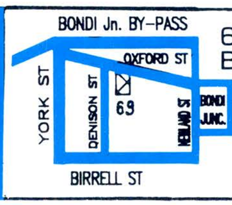

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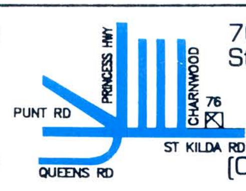

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NUMBERS COUNT

END ZONE

Mike Mudge goes back to basics . . . how large is a large integer? He also looks at the results, and some of your ideas, to May's Geometry of Numbers problem.

The primary requirement in empirical number theory is to escape from 'the largest integer which can be *handled* is $2^{32} - 1$' (= 4294967299) or similar restriction to be found in the user manuals of all personal computers.

Now, what is meant by 'handling' a large integer?

(a) Identification Ideally using a single identifier, as with conventional integers (maybe prefixed by L for 'long'), but possibly using an array-type declaration.

(b) Input and output It is essential to provide a facility enabling a large integer to be input to memory. Such a facility may require the integer to be accompanied by a parameter defining its length, either in digits or some other convenient unit; and should contain a sum-check to detect the majority of keying errors.

The output of a large integer need not be accompanied by the length-defining parameter: however, attention should be paid to formatting in relation to the output device in use. Spurious line-filling characters should be avoided and the conventional form of right justification is desirable, although not essential.

(c) Very simple arithmetic *Addition* and *subtraction* of large integers are to be readily available, called through either user-named functions (or procedures) or ideally in the natural manner with + and − linking the appropriate indentifiers.

(d) Simple arithmetic *Multiplication* of large integers should be carried out with any possibility of unreported overflow removed; in general, reported overflow *(Note: since all computers have a finite capacity, overflow is ultimately unavoidable)* must be accompanied by termination of the program.

(e) Not-so-simple arithmetic *Division:* we are unable to subscribe to the philosophy of the eminent number theorist DH Lehmer — 'Not only should division by zero be excluded from arithmetic, but all division should be avoided . . .' Division should produce a quotient and a remainder, both of which may be very large: a trivial example 1234567898/231 yields 3846005 remainder 293. Decimal places are *not* relevant and floating-point arithmetic should be avoided in general.

Partial factorisation is a desirable standard subroutine, assuming the accessibility of a 'table' of prime numbers up to a given maximum. An efficient division routine with a test for non-zero remainder will clearly expedite this procedure.

Determination of integer roots (or rational powers). The determination of square, cube, fourth . . . roots of large integers — *only when these are integers* — is a desirable facility and can clearly be related to the factorisation algorithm referred to above. For example, $7\surd(105413504) = 7\surd(2^7.7^7) = 2.7 = 14$.

A Computation of Devi The following 201 — digit integer had its 23rd root extracted mentally by Miss Shakuntala Devi in 50 seconds. A Univac 1108 computer at The National Bureau of Standards, Washington, using 13,000 pre-programmed instructions, repeated the calculation in one minute!

916748676920039158098660927585380162483106680144308622407126516427934657040867096593279205767480806790022783016354924852380335745316935111903596577547340075681688305620821016129132845546805780158806771

Specimen problem

Input the large integer 123456789101112131415. . . .n, calculate its n^{th} power and output this, together with its factors. What is the maximum n which your computer will handle? For example, $n = 2$, $12^2 = 144 = 2^4.3^2$, $n = 3$, $123^3 = 1860867 = 3^3.41^3$.

Readers are encouraged to investigate the efficient manipulation of large integers using techniques ranging from array facilities in high-level languages such as Basic, Pascal or Fortran, through general string handling to machine code/assembler coding. The specimen problem together with the computation of Devi should be attempted.

Achievements may be submitted to Mike Mudge, C/- *APC*, 2nd Floor, 215 Clarence Street, Sydney 2000, to arrive by December 15, 1986. It would be appreciated if such submissions contained a brief summary of results, together with thoughts relating to the associated outstanding problems, in a form suitable for future publication in *APC*.

These submissions will be judged using suitably vague criteria, not necessarily related to the answer to Devi's Computation! A prize will be awarded to the 'best' contribution received by the closing date.

Please note that submissions can only be returned if a suitable stamped, addressed envelope is provided.

Mike Mudge welcomes correspondence on any subject within the areas of number theory and other computationally related mathematics, particularly containing suggestions for future 'Numbers Count' articles, and will endeavour to reply to all letters after a sufficiently long time.

Review — The Geometry of Numbers

Relatively few graphics enthusiasts answered the call of May's problem. The typographical error in question five, line three — the word 'lattice' should be deleted — brought rapid response from several careful readers; however, question five, problem E, proved to be too abstract. Further comments relating to it would still be very welcome.

Any reader interested in the mathematical background of this topic is encouraged to consult Minkowski's classic work, *The Geometry of Numbers.* Those particularly interested in question four, problem C, are referred to C Hylten-Cavallius, 'On a combinatorial problem', *Colloq Math,* vol six, 1958, pp 59-65.

Richard Tindall, a regular correspondent, has dealt effectively with problems A and B, and having confirmed the known results of problem D, has conjectured (without proof) results for n = 8 and 9. Problem C was Richard's chief interest and I feel sure that he would share the details of his approach upon receipt of a stamped, addressed envelope C/- *APC*.

The prize-winner this month is John Gale with an Epson MX80 and programmed in Microsoft Basic. John's approach to graphical display of lattice points was simple but effective, and his attempts to relate results in the geometry of numbers to rational approximations (best-possible in some sense) to certain transcendental numbers were enthusiastic, if not greatly productive.

END

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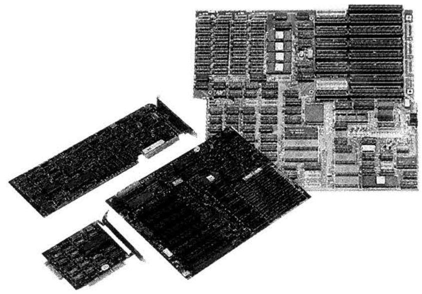

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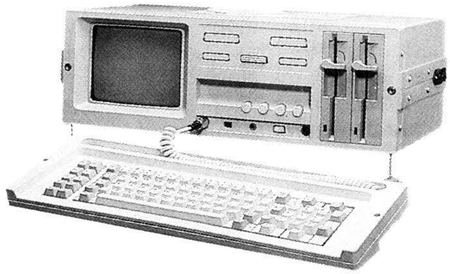

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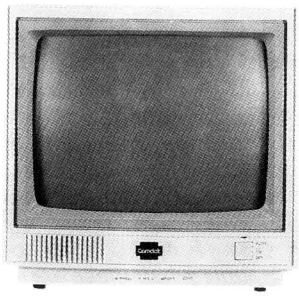

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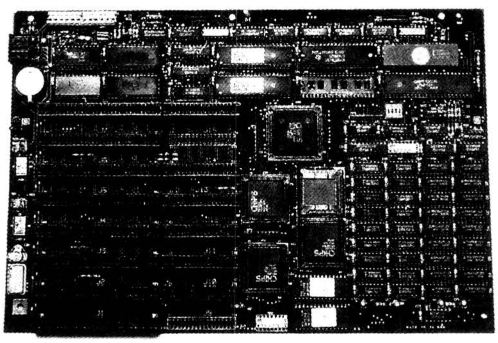

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DIARY DATA

Readers are strongly advised to check details with exhibition organisers before making travel arrangements to avoid wasted journeys due to cancellations, printers' errors, etc.

Sydney	Infotex '86 Contact: Richard May or Alan Tayt (02) 959 5555	November 4-6, 1986
Hong Kong	Software Exhibition '86 Contact: Nelson Tse, Tel: (3) 723 5656	November 4-6, 1986
Las Vegas, US	Comdex/Fall '86 Contact: Linda Yogel, Comdex/Fall '86, 300 First Avenue, Needham, Mass 02194, US Tel: (617) 449 6600	November 10-14, 1986
Montpellier, France	IDATE Contact: Bureaux du Polygone, Rue des Etatsdu-Languedoc, 34000, Montpellier, France Tel: 67 65 4848	November 17-19, 1986
Bangkok	SEARCC '86 Contact: TIG Australia Inc, 8 West St, Nth Sydney (02) 959 5555	November 17-21, 1986
Singapore	Automasia '86 Contact: Australian Exhibition Services, Suite 3.3, 424 St Kilda Road Melbourne 3004 (03) 267 4500	November 18-22, 1986
Geelong	IREECON Contact: Heather Harriman (02) 29 4051	November 30-December 4, 1986

LAZING AROUND

Brain-teasers courtesy of JJ Clessa.

My wife went shopping last Saturday and bought three items from successive shops. At each shop, the item she bought cost threequarters of the money she had in her purse at the time. She came home with 10 cents only. How much did she have in her purse at the outset?

Prize puzzle

This will get the micros whirring.

To multiply 77 by 23, you put the single digit '1' before and after the answer 1771.

To multiply 91 by 32, you put the single digit '2' before and after the 91 to give the answer 2912.

To multiply 411 by 83, you put the single digit '3' before and after the 411 to give the answer 34113.

What is the smallest number that you could multiply by 29 using this method, and what would be the single digit which you would use?

Answers on postcards or backs of envelopes only, please, to reach *APC*, Prize Puzzle November, 2nd Floor, 215 Clarence Street, Sydney 2000, no later than 15 December 1986.

August prize puzzle

A lot of entries this month — denoting a rather easy problem.

We were rather fascinated by a card from a Mr Wesencraft who claimed that he had a 'truly wonderful proof' that the sum of the first four digits of any answer must be 10 but, unfortunately, his postcard was too small to contain it!

We certainly don't know of this proof but it sounds plausible, and certainly holds for the three answers we have which are:

54748 (the smallest)
92727
93084

The winning entry, drawn at random, came from Mr M Fraser of Sandy Bay, Tasmania.

Congratulations — your prize is on its way. Meanwhile — keep puzzling.

END

BENCHMARKS

A list of Benchmarks used when evaluating micros is given below. An explanation can be found in the February '84 issue.

```
100 REM Benchmark 1
110 PRINT "S"
120 FOR K=1 TO 1000
130 NEXT K
140 PRINT "E"
150 END

100 REM Benchmark 2
110 PRINT "S"
120 K=0
130 K=K+1
140 IF K<1000 THEN 130
150 PRINT "E"
160 END

100 REM Benchmark 3
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/K*K+K-K
150 IF K<1000 THEN 130
160 PRINT "E"
170 END

100 REM Benchmark 4
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/2*3+4-5
150 K<1000 THEN 130
160 PRINT "E"
170 END

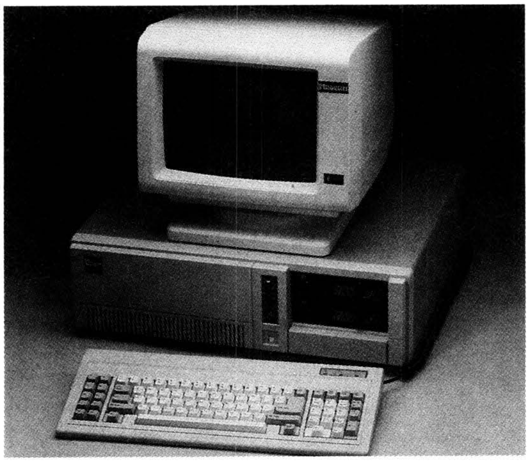
100 REM Benchmark 5
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/2*3+4-5
150 GOSUB 190
160 IF K<1000 THEN 130
170 PRINT "E"
180 END
190 RETURN

100 REM Benchmark 6
110 PRINT "S"
120 K=0
130 DIM M(5)
140 K=K+1
150 A=K/2*3+4-5
160 GUSUB220
170 FORL=1 TO 5
180 NEXTL
190 IF K<1000 THEN 140
200 PRINT "E"
210 END
220 RETURN

100 REM Benchmark7
110 PRINT "S"
120 K=0
130 DIM M(5)
140 K=K+1
150 A=K/2*3+4-5
160 GOSUB 230
170 FOR L=1 TO 5
180 M(L)=A
190 NEXTL
200 IF K<1000 THEN 140
210 PRINT "E"
220 END
230 RETURN

100 REM Benchmark 8
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K 2
150 B=LOG(K)
160 C=SIN(K)
170 IF K<1000 THEN 130
180 PRINT "E"
190 END
```


BEST COMBINATION & BEST PRICE!



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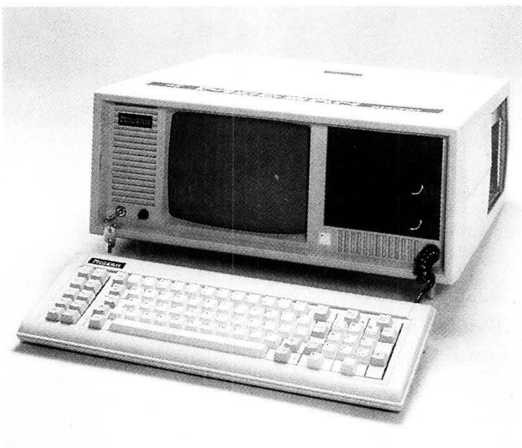

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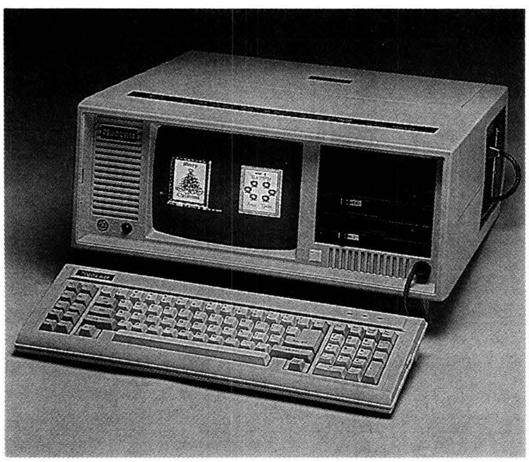

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END ZONE

USER GROUPS UPDATE

Below is a list of updates and additions to the full User Group Index published in the June issue of APC. The next full listing will appear in the December issue of APC.

NEW SOUTH WALES

A monthly newsletter/magazine is available for VZ 200/300 users. For more details send a SAE to: Mark Harword, PO Box 154, Dural NSW 2158.

ACT

The PC Users Group, Inc (ACT) caters for 16-bit micros using PC/MS-DOS or CP/M-86. The group meets on the last Monday of each month at 8pm at the Coombs Lecture Theatre, Australian National University. A mid-month meeting is also held (second or third Wednesday, as advised) at the Colloquium Room, Jaeger Building, Australian National University, commencing at 8pm. For more details contact: Secretary, PC Users Group Inc, GPO Box 2229, Canberra ACT 2601. Tel: (062) 80 5954 (Chess Krawczyk. Bulletin Board (062) 58 9967.

The following SIGs operate within the PC Users Group Inc.

NAME OF GROUP:	CATERING FOR:	MEETINGS:	CONTACT:
Sanyo SIG	Sanyo MBC 550/555	Meets on first Monday of each month, 7.30pm at the Blair Room, Canberra Workers' Club.	Sanyo SIG GPO Box 2229 Canberra ACT 2601 (062) 91 6194 (AH) Mike Cassidy
Government Systems SIG	Those working with microcomputers in Parliament, the Judiciary, Government departments and authorities	Meets on first Wednesday of each month at 4.30pm at Silverton Centre, Rudd Street.	Government Systems SIG GPO Box 2229 Canberra ACT 2601 (062) 48 4815, Bruce Rossell
Survey and Statistics SIG	Those using microcomputers for statistical analyses and for preparation and execution of surveys.	Meets bi-monthly	Survey and Statistics SIG GPO Box 2229 Canberra ACT 2601 (062) 97 2697 (AH) Bill Fitzgerald
C Language SIG	C Programmers	Meets on first Wednesday of each month, 8.00pm at the seminar room of the Jaeger Building, ANU.	C Language SIG GPO Box 2229 Canberra ACT 2601 (062) 58 3169 (AH) Cedric Bear
Com SIG	Computer communications	At mid-month meetings.	Com SIG GPO Box 2229 Canberra ACT 2601 (062) 58 9081 (AH) Alan Salmon
CAD SIG	Those interested in CAD applications		CAD SIG GPO Box 2229 Canberra ACT 2601 (062) 30 2508 (AH) Frank Taplin
Open Access SIG	Open Access users		Open Access SIG GPO Box 2229 Canberra ACT 2601 (062) 81 2273, Warren Colledge
Apricot SIG	Apricot microcomputers		Apricot SIG GPO Box 2229 Canberra ACT 2601 (062) 58 6677 (AH) Barry Zazoniuk
Laptops SIG	Laptop microcomputers		Laptops SIG GPO Box 2229 Canberra ACT 2601 (062) 88 0027 (AH) Ray Roche

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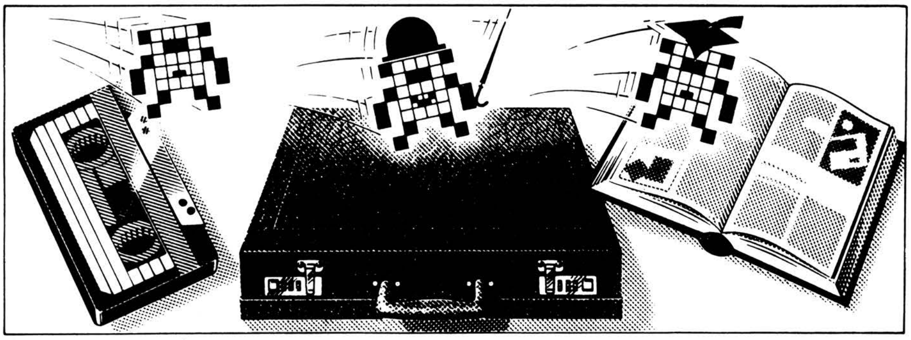
- DUAL ROW SOCKET 10,14 — 60, 64 Ways for flat cable.
- SINGLE and DUALROW PIN HEADER.

- GPIB. IEEE-488 INTERFACE CABLE.
- RS-232 CABLE.
- CENTRONIC CABLE.
- MODEM CABLE.
- IBM PRINTER CABLE.
- IBM PC/XT, AT DRIVE CONTROL CABLE.



Games

Scientific/mathematic

Business

Toolkit/utilities

Educational/Computer Aided Learning

Owen Linderholm selects the best of readers' programs. For details on submitting your own, see the end of this section.

There has been a generally positive response to the changes to 'Program File'. These changes were to introduce more documentation and commenting to make programs easier to understand. In addition, I have tried to have the Program of the Month accompanied by a decent introduction which explains how the program was written and how it works. I'm hoping to extend this policy to cover more of 'Program File', in order that all the long programs are accompanied by documentation which reveals how the programs are written and why the program was written in the way it was.

The hints and tips section of 'Program File' will not be affected, and I hope to continue to receive any snippets of hardware or software knowledge that you have discovered about your machines.

Due to the aforementioned change, readers should send in much more thorough documentation with their programs. It should include information on how to run the program, any idiosyncrasies or alternative versions, reference to machine-specific parts of the code, why the program was written, how it was written, and some indication of why particular algorithms or data structures have been used.

These changes, which will take a few months to implement, should result in 'Program File' being easier to understand and more interesting. So, if you're thinking of submitting anything to 'Program File', please bear these things in mind.

This month's programs

The Program of the Month is an unusual and extremely useful utility written by Jim McCartney. It's called Snoopy, and its purpose is to examine and modify records from all sorts of programs, especially databases. The format in which records are stored can be decoded so that they can be used by other programs or accessed by user-written ones. It can also be used to edit the records and then save them.

The program works slowly and is best compiled by something like Microsoft's QuickBasic. One limitation of the program is that it is designed to be used with fixed-length records. It's still possible to access variable records, but it's difficult to do in a completely organised way.

The program could be used to analyse records, and also as a stepping stone to writing other programs which use records that this program has analysed. File records could then be manipulated in all sorts of additional ways than are provided by the original program.

There's a utility to provide simple disk management functions on a wide range of Commodore computers and disk drives. The program works with the C1541 disk drive, the 1570 disk drive in C64 mode, the Pet disk drives, and with *all* Commodore computers that drive these disk drives.

For the BBC, there's a program to assist with installing ROMs in the machine, or programs in sideways RAM that are to act as if they are ROMs. The program creates and writes to disk a machine code file that provides the necessary header to install these programs.

There's a large selection of tips this month, including Commodore 64 IRQ program installation.

Program of the Month

MBasic Snoopy

by Jim McCartney

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *66637#.

In business, one of the regular requests to Micro Support is for special reports from data generated by package programs. Quite a lot of packages will supply you with a report generator for this purpose (at a good price, mind you) and some software houses will tell you the data fieldings, if you ask nicely.

There remains a substantial number of packages with which you can't get at the data easily because you don't know how it's fielded. Admittedly, a session with Norton Utilities may throw some light on it, but the time which needs to be spent in working out double-precision numbers from the hexadecimal usually defeats all but those who have nothing better to do.

The following program is designed as a versatile tool to deal briskly with this problem, on IBM and compatibles — and primarily for Basic-A style random access records — although it can read any DOS files. Besides decoding records, it can also be used to edit text bytes or hex nybbles, and save the resulting record back where it came from.

Records may be printed out in a variety of ways.

The program does not include any disassembler facility — it is designed for data.

To get the best out of it, the program should be compiled, because interpreted Basic won't let you handle a string longer than 255 characters and records are handled as strings. Besides, the amount of work it has to do makes it fairly sluggish on a PC or XT unless it's compiled, though leaving out the REMs will help. The code uses Basic-A version 3.0, which includes the useful SHELL; but if you don't have this version, you can do without the fancy bits from lines 690–820, which are mainly to save you having to type-in tedious pathnames. To fix this, delete lines 690–830, and make line 820 as follows:

```
820 M$=" ENTER DRIVE:/PATH/
FILENAME TO INSPECT ": GOSUB
390: CLS: FIL$=Q$: A$="": IF Q$=""
THEN END
```

delete the KILL in 1460, and change "770" to "820" in lines 1470 and 2880.

Records under Basic-A

Using Basic-A, you can open any file you like as a random access file with an arbitrary record length — it doesn't matter if it's a text file, a binary file or a genuine data file. All characters (including the text end-of-file marker, Hex 1A) are treated as part of the data. If it was originally a random access file with a specific record length, you can open it with the original or any other record length you please. Of course, this leads to the problem of finding out what the original record length really was, since there's nothing in the record or in the DOS to tell you. The program (which I have dubbed Snoopy) checks the file length (LOF) and asks you for the number of records (you will usually know this), and works out the record length. However, it doesn't insist on it, and if you want to chop, say, a 512-byte record into convenient 64-byte pieces for easier handling, you are welcome to do so.

The DUMP facility

There's a facility to dump one or more records to the printer in hex format, text format, or both. The program asks you for your printer width to set the WIDTH parameter to an appropriate figure, and assumes that CHR$(15) will produce condensed print. Fig 1 shows a hex and text dump on a payroll record, originally 384 bytes long but broken down into 12 32-byte lines for convenience. This is also a useful tool for developing your own applications (what happened to that field?) and for investigation of data corruption problems. Inspection of this type of dump will help you with the analysis, by letting you see the whole record, or several records, at once.

The analysis

You first select a file and a record length, and a record (default no 1) for analysis. This is displayed on-screen as shown in Fig 2, initially starting at Byte 1. Reading the columns from left to right, we have:

1) The byte number.
2) The byte value in hex.
3) The ASCII text, if appropriate (otherwise a dot).
4) The interpreter string.
5) The interpretation

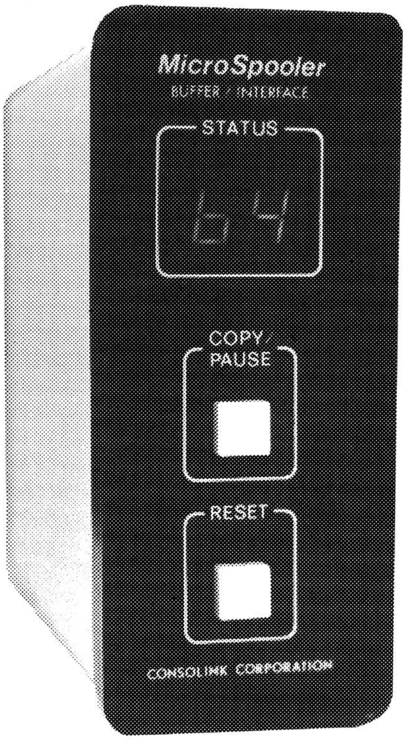
— and at the bottom, a function key menu.

The interpreter string is the key to the operation of the program. It's a string the same length as the record, and its initial state is such that any bytes in the record to be analysed whose values lie in the range 32 to 126 are interpreted tentatively as text characters — the same as in the DUMP. It accomplishes this by setting the corresponding byte in the interpreter string to 't'. If you have some undoubted text, you can confirm this by pressing 'T' on the keyboard for each corresponding byte. This will change the letter in the interpreter string to upper case, which prevents it being overwritten by further tentative interpretations. Should you be working with a text file, the more common text control characters such as CR and LF are displayed (listed in 160–190), or failing this, as in the IBM character set.

The up and down arrows, Home, End, Page Up and Page Down do what you would expect them to do, although the up arrow is a bit tedious at the top of the screen since I have made no special provision for back-scrolling. Entering a letter corresponding to one of the data types below moves the cursor down the corresponding number of bytes.

The program recognises the following data types:

1) Text, as explained.
2) Bytes: that is, numbers in the range 0 to 255.
3) Integers: any two consecutive bytes may be interpreted as an integer.
4) Single-precision floating point numbers. Any four consecutive bytes may be so interpreted. However, in order to eradicate improbable numbers, press function key 8; this will interpret only those numbers in the range ABS(.0001 to 999999.999 — that is, those numbers which you are most likely to come across in accounting; things like 3.479167E-16 are ignored. F8 will toggle between the maths and accounting formats. In the accounting format, numbers outside the range are marked as a star. Zeros are not interpreted because there are a lot of them about, usually.
5) Double-precision floating point numbers, interpreting eight bytes in the same way.
6) Integer dates (type X) as the number of days from 1.1.1970 to 2000.
7) Ditto (type Y) from 11.1980 to 2000.
8) Single-precision dates (type Z)



MicroSpooler

You no longer have to wait on the printer, as the micro spooler can complete the job in a matter of seconds.

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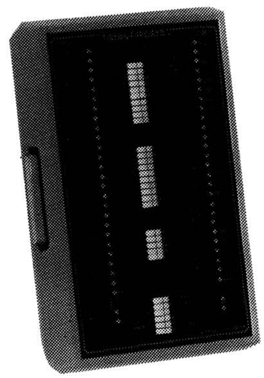
Features include:

- ⋆ 16K Memory: User or factory expandable to 256K.
- ⋆ Multiple Copy Function.
- ⋆ Status Readout: Tells you how much data is stored or how many copies are left to run.
- ⋆ Pause Function: To let you change paper, make adjustments.
- ⋆ Self-Test Routine: Performs a comprehensive check of most internal functions and memory.
- ⋆ Internal Power supply: No bulky plug adapters.
- ⋆ Vertical Mount Configuration and Size: Saves desktop space.
- ⋆ Plug-in connections to most computer combinations.
- ⋆ Independently selectable Baud Rates on Serial Ports.
- ⋆ Twelve Months Warranty.
- ⋆ Four Models: any Combination of Parallel or Serial 1/0.

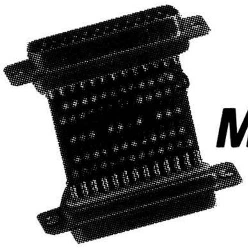
Datatracker



- ⋆ Compare RS-323 interfacing.
- ⋆ Full 25 line cable diagnostics.
- ⋆ Troubleshooting DTE & DCE devices.
- ⋆ Installation tool for multi-user systems.
- ⋆ Software development & hardware design aid.
- ⋆ 50 input display panel for custom monitoring situations.

Features:

- ⋆ User friendly layout.
- ⋆ Monitors all 25 pins of both DTE & DCE simultaneously.
- ⋆ High, low, clocking & off indication for all 50 inputs.
- ⋆ Visual indication of relative signal strength.
- ⋆ Built-in crossover capability for pins 2 & 3.
- ⋆ Complete cable tracing and testing without opening hood.



Micro Patch

For permanent on-site or workshop hard wire cabling without solder.

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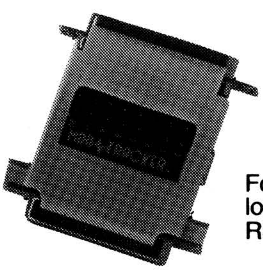
- ⋆ Simple to use.
- ⋆ Instantly connects virtually all RS-232 computers and peripherals.
- ⋆ No batteries or power supply required.
- ⋆ Automatically reconfigures when you plug in different equipment.
- ⋆ Correctly links data lines and handshakes.



Mini Tracker

For visual indication of high and low signals on commonly used RS-232 pins, (2,3,4,5,6,8,11,20).

AB Office Electronics

383 Sydney Rd., Balgowlah, N.S.W.
P.O. Box 272, Balgowlah 2093
Australia

Telephone: 949 7422

which interpret a mathematical integer in single-precision format as a date in the range 1.1.1900 to 2000.

These are the date formats which I have found in most common use, but there may be others.

Having removed obvious text, you can interpret the rest of the record tentatively as any of the above types, by pressing ALT with the corresponding letter. At this point, it's a great help to have the data from the original program printed or written in whatever form it may be available. Press F8 then ALT-S, and you can see at once if there's any accounting data held in single-precision form. ALT-Z is a complete giveaway for that kind of data, because the probability of any four random bytes coming across as a single-precision number which is both integer and in the range 1 to 36525 is minute. If you compare the interpretations with your original data, you can 'fix' any data by pressing the corresponding key on the first byte, without the ALT. This converts the interpreter string to upper case, which is proof against over-writing with further tentative interpretations. A dash, '–', disables the interpretation of a byte.

When all or most of your record has been interpreted, you can select another record with F6 and see how it looks with the same interpreter string. This helps to clear up any ambiguities. If, instead, you get in a mess, use F7 to restore the original default interpretation.

You can dump a screen in the usual way with PrtSc (Fig 2), but F10 will print the entire record as you see it onscreen.

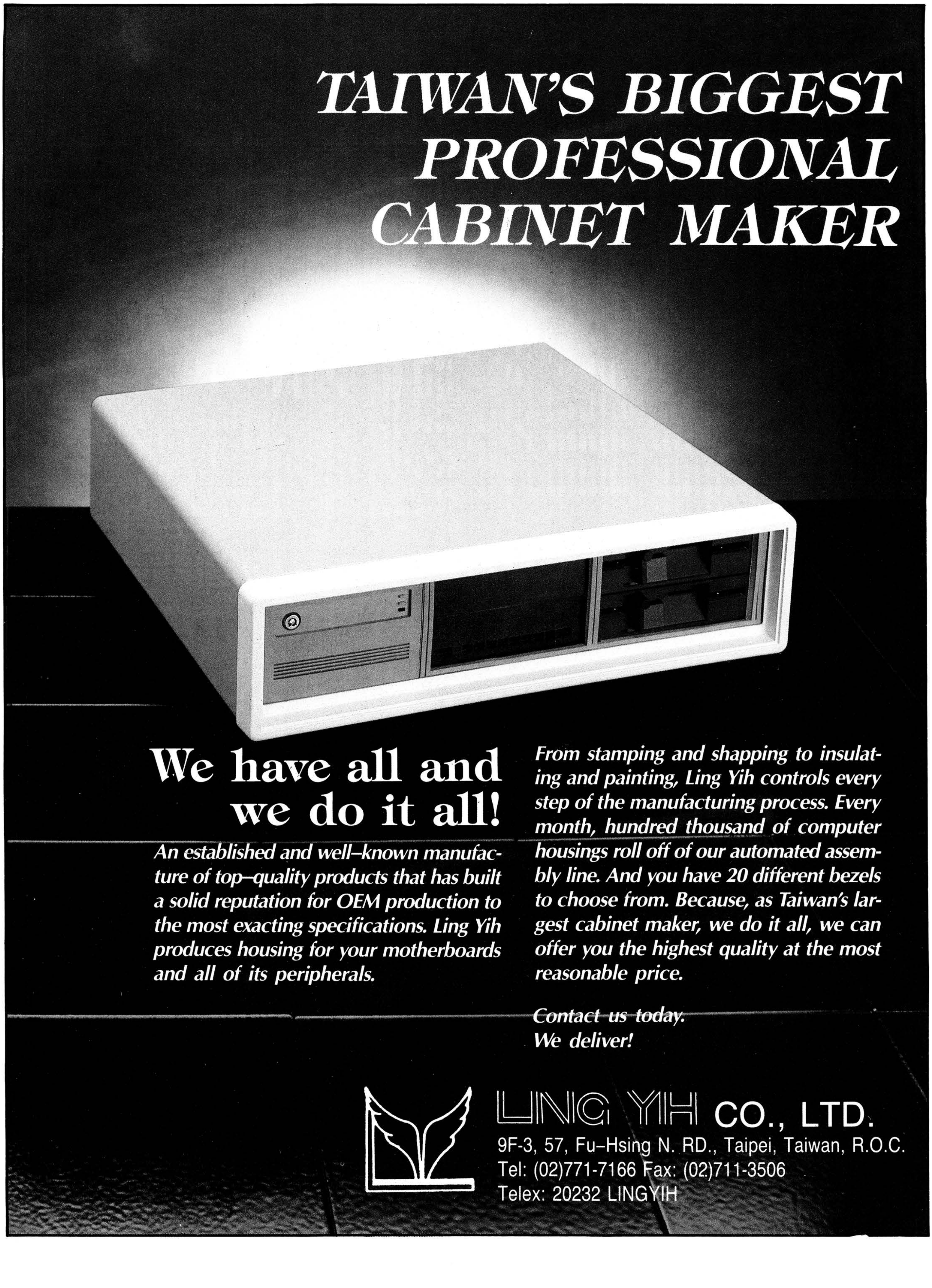
If you come across data which doesn't seem to correspond to any of the data you put into the record, suspect status flags (usually bytes) or pointers or links to other records (usually integers) which may be in other files.

Editing

You can change the data in the record by shifting the cursor to the second or third columns (left and right arrows) and pressing any valid text or hex value key. You can also save changes made by using F9 — with extreme caution on live data! It isn't possible, however, to edit numeric data directly in the same way as text, but you can change numeric data by editing the hex, since you can see the effect on the number displayed immediately. In this respect, the significance of the nybbles increases as you move left and downwards — it isn't hard to get the number you want by successive approximation, and you'll gain much insight into the storage of floating point numbers!

```
100     '*********************************************************************
110     '***          RECORD CONTENTS ANALYSIS PROGRAM "SNOOPY.BAS"          ****
120     '***                   J. McCartney    May 1986                      ****
130     '*********************************************************************
140     ON ERROR GOTO 2880
150     KEY OFF: FOR J%=1 TO 10: KEY J%,"": NEXT
160     DATA    "NULL","","","","","","","BEEP"
170     DATA    "BACKSPACE","TAB","LF","HOME","FF","CR","",""
180     DATA    "","","","","","","",""
190     DATA    "","","EOF","ESC","CURS RIGHT","CURS LEFT","CURS UP","CURS DOWN
200     DIM Q$(31): FOR Q%=0 TO 31: READ Q$(Q%): NEXT
210     N$="-": T$="T": B$="B": I$="II": X$="XX": Y$="YY": Z$="ZZZZ": S$="SSSS":
        D$="DDDDDDDD": UC%=95: LC%=32: A1=999999.9999£: A2=.0001:
        P$="######.####": BL$="                  "
220     DIM C%(6): DATA 31,35,36,40,44,48: FOR J%=1 TO 6: READ C%(J%): NEXT
                                                         'column positions
230     DIM A$(8),R$(8)
240     MO$="312831303130313130313031"
250     PR$=":1 HELP:2 END :3 PATH:4 FILE:5 DUMP:6 REC :7 CLEAR:8 ACCT:9 SAVE:10
 PRINT:"
260     GOTO 670
        '
270     '********************** UTILITY SUBROUTINES ***************************
```

```
280     BEEP
290     Q$=SPACE$(39-LEN(M$)/2): LOCATE 25,1: COLOR 0,7:
        PRINT Q$;M$;Q$;: COLOR 7,0: RETURN                 'print a message M$
        '
300     GOSUB 280: FOR J=1 TO 10000: NEXT
310     LOCATE 25,1: PRINT SPACE$(78);: RETURN             'message,pause,delete
        '
320     GOSUB 280: Q$="": LOCATE 1,1: Q%=ASC(INPUT$(1)) AND 95:
        IF Q%=13 THEN Q$=DE$
330     IF Q%=65 THEN Q$="A"
340     IF Q%=78 THEN Q$="N"
350     IF Q%=68 THEN Q$="D"
360     IF Q%=89 THEN Q$="Y"
370     IF Q$="" THEN 320
380     GOSUB 310: RETURN                                  'message; Y/N/A/D answer
        '
390     Q$=SPACE$(78-LEN(M$)): LOCATE 25,1: COLOR 0,7: PRINT M$;Q$;: COLOR 7,0:
        LOCATE 25,LEN(M$)+1: LINE INPUT Q$: RETURN         'prompt M$; input Q$
        '
400     GOSUB 390: Q%=VAL(Q$): IF Q%<L% OR Q%>U% THEN CLS: BEEP: Q%=-1
410     RETURN                                             'prompt M$; input Q%
        '
420     Q%=ASC(R1$): IF Q%<32 OR Q%>126 THEN Q1%=46 ELSE Q1%=Q%
430     RETURN                                             'text or "." if not
        '
440     IF      AFLAG%=0 THEN PRINT A;: RETURN
450     IF      ABS(A)>A1 OR ABS(A)<A2
        THEN    PRINT "*"+BL$; ELSE PRINT USING P$;A;: RETURN
                                                           'accounts or maths
460     CL%=CSRLIN: CC%=POS(0): CA%=(SCREEN (CL%,CC%,1)) MOD 16:
        IF CA% THEN COLOR 0,7 ELSE COLOR 7,0
470     PRINT CHR$(SCREEN(CL%,CC%,0));:
        IF CA% THEN COLOR 7,0 ELSE COLOR 0,7               'reverse chr at cursor
480     LOCATE CL%,CC%: RETURN
        '
        '********************** INTERPRET A BYTE *****************************
490     A1$=MID$(A$,K%,8): R1$=MID$(R$,K%,8):
        FOR A%=1 TO 8
500              A1%=ASC(MID$(A1$,A%)):
                 IF A1%>95 THEN MID$(A1$,A%)=CHR$(A1%-LC%)
510     NEXT                                               'convert to upper case
520     LOCATE L%,C%(1): PRINT MID$(STR$(K%),2);           'byte number
530     LOCATE L%,C%(2): PRINT RIGHT$(("0"+HEX$(ASC(R1$))),2); 'hex code
540     LOCATE L%,C%(4): GOSUB 420: PRINT CHR$(Q1%);       'text if applicable
550     LOCATE L%,C%(5): PRINT MID$(A$,K%,1);              'interpreter string
560     LOCATE L%,C%(6):
                 IF LEFT$(A1$,1)=N$ THEN 650
                           'null
570              IF LEFT$(A1$,1)=T$ THEN IF Q%<32 THEN IF Q$(Q%)="" THEN
                 PRINT CHR$(Q%);:GOTO 650 ELSE PRINT Q$(Q%);:GOTO 650
                 ELSE PRINT CHR$(Q%);:GOTO 650                     'text
580              IF LEFT$(A1$,1)=B$ THEN PRINT Q%;:                GOTO 650
                           'byte
590              IF LEFT$(A1$,2)=I$ THEN PRINT CVI(R1$);:          GOTO 650
                           'integer
600              IF LEFT$(A1$,2)=X$ THEN GOSUB 2120: PRINT DT$;:   GOTO 650
                           'date 1970 base
610              IF LEFT$(A1$,2)=Y$ THEN GOSUB 2130: PRINT DT$;:   GOTO 650
                           'date 1980 base
620              IF LEFT$(A1$,4)=S$ THEN A=CVS(R1$): GOSUB 440:    GOTO 650
                           'sp real
630              IF LEFT$(A1$,4)=Z$ THEN GOSUB 2140: PRINT DT$;:   GOTO 650
                           'date 1900 base
640              IF LEFT$(A1$,8)=D$ THEN A=CVD(R1$): GOSUB 440:    GOTO 650
                           'dp real
650     PRINT BL$;: RETURN
        '
660     '********************** INITIAL PROCEDURES ***************************
        '********************** SELECT DIRECTORY
670     CLS: LOCATE 1,28: COLOR 0,7: PRINT "Records Analysis Program":COLOR 7,0
680     CLS:DE$="Y": M$="HAVE YOU A WIDE (14 inch) PRINTER ? <Y> ": GOSUB 320:
        PW1=224: PW2=132: IF Q$<>"Y" THEN PW1=136: PW2=80
682     M$=SPACE$(20)+"PLEASE ENTER DRIVE (A to Z) <C> ": GOSUB 390
683     IF Q$="" THEN Q$="C"
684     Q%=ASC(Q$) AND 95: IF Q%<65 OR Q%>90 OR LEN(Q$)>1 THEN BEEP:
        GOTO 682 ELSE DSK$=CHR$(Q%)+":"
686     OPEN DSK$+"ZZZZZZZZ" FOR OUTPUT AS #1: CLOSE: KILL DSK$+"ZZZZZZZZ"
688     LOCATE 3,1
690     Q$="TREE "+DSK$+">D1.TMP":SHELL Q$: Q1$="\"
700     OPEN  "D1.TMP" FOR INPUT  AS #1
710     OPEN  "D2.TMP" FOR OUTPUT AS #2
720     PRINT #2,DSK$
730     WHILE NOT EOF(1)
```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```
740          LINE INPUT #1,Q$: IF INSTR(Q$,Q1$)=0 THEN 760
750          Q$=MID$(Q$,INSTR(Q$,Q1$)): PRINT #2, DSK$;Q$
760     WEND: CLOSE                                        'directories in D2.TMP
770     D%=0: OPEN "D2.TMP" FOR INPUT AS #1: LOCATE 3,1
775     CLS: LOCATE 1,28:COLOR 0,7: PRINT " DIRECTORIES ARE: ":COLOR 7,0: PRINT
780     WHILE NOT EOF(1): D%=D%+1: INPUT #1,Q$:
        PRINT TAB(27);D%;TAB(35);Q$: WEND: CLOSE        'directories menu
790     M$="            SELECT DIRECTORY (1 to"+STR$(D%)+") ":
        L%=1: U%=D%: GOSUB 400: IF Q%=-1 THEN 770
800     OPEN "D2.TMP" FOR INPUT AS #1: FOR J%=1 TO Q%: INPUT #1,Q$: NEXT: CLOSE
810     DIR$=Q$: DI$="dir "+Q$+"\*.*/W | MORE"
        '
        '********************* SELECT FILE
820     CLS: SHELL DI$
830     M$="            ENTER FILE NAME TO INSPECT ": GOSUB 390: CLS:
        FIL$=DIR$+Q1$+Q$: A$="": IF Q$="" THEN END      'select a file
840     OPEN "R",#1,FIL$: FL=LOF(1): CLOSE              'is it there?
850     IF FL=0 THEN M$="No such file !": GOSUB 300: KILL FIL$: GOTO 820
                                                         'kill a file of length 0
860     CLS: LOCATE 1,20: COLOR 0,7: PRINT "ANALYSIS ON ";FIL$;" LENGTH ";FL:
        COLOR 7,0: PRINT
        '
870     '********************* RECORDS / SIZE
880     M$=SPACE$(30)+"NUMBER OF RECORDS ? ": L%=0: U%=32767: GOSUB 400
890     IF Q%=-1 THEN 880
900     IF Q%=0 THEN DE$="Y":
        M$="NUMBER OF RECORDS NOT KNOWN - OK ? <Y>": GOSUB 320:
        IF Q$="Y" THEN 930 ELSE 880
910     NR%=Q%: RL=FL/NR%: IF RL<>INT(RL) THEN DE$="Y":
        M$="NUMBER OF RECS. IS NOT A FACTOR OF FILE SIZE - OK ? <Y>": GOSUB 320:
        IF Q$="Y" THEN 930 ELSE 880
920     DE$="Y": M$="RECORD LENGTH IS"+STR$(RL)+" OK ? <Y>": GOSUB 320:
        IF Q$="Y" THEN 950
930     M$=SPACE$(30)+"RECORD LENGTH ? ": L%=1: U%=32767: GOSUB 400: RL=Q%:
        NR=INT(FL/RL)+1: IF NR>32767 OR NR<1 THEN 880 ELSE NR%=NR: GOTO 920

940     '********************* WHAT TO DO
950     M$="DO YOU WANT ANALYSIS (A) OR DATA DUMP (D) ? <A>": DE$="A":
        GOSUB 320: IF Q$="D" THEN GOTO 2610

960     M$=SPACE$(30)+"RECORD TO ANALYSE ? <1>": L%=0:U%=NR%:
        IF U%=0 THEN U%=32767
970     GOSUB 400: RN%=Q%: IF RN%=0 THEN RN%=1           select suitable record

980     '********************* INITIAL DISPLAY ****************************
990     OPEN "R",#1,FIL$,RL: FIELD #1, RL AS R$: GET #1,RN%
1000    IF A$<>"" THEN 1030
1010    A$=STRING$(RL,45):
        FOR J%=1 TO RL:
              Q%=ASC(MID$(R$,J%)): IF Q%>31 AND Q%<127 THEN MID$(A$,J%)="t"
1020    NEXT                                             'find possible text
1030    X%=1: M%=5: GOTO 1810                            'first page

1040    '********************* INTERACTIVE ANALYSIS ************************
1050    IF M$<>PR$ THEN M$=PR$: GOSUB 290: LOCATE L%,C%(M%): COLOR 0,7:
        PRINT CHR$(SCREEN (L%,C%(M%)));: COLOR 7,0: LOCATE L%,C%(M%)
1060    Q$=INKEY$: IF Q$="" THEN 1060
1070    IF LEN(Q$)=2 THEN Q%=ASC(MID$(Q$,2))+200 ELSE Q%=ASC(Q$)
                                                         'extended codes add 200

1080    IF Q%=275 THEN IF M%>2 THEN M%=M%-1: GOTO 1850   'cursor left
1090    IF Q%=277 THEN IF M%<5 THEN M%=M%+1: GOTO 1850   'cursor right

1100    IF Q%<>280 THEN 1140                             'down a line
1110    IF K%>=RL THEN 1870                              'skip if end if record
1120    IF L%<24 THEN L%=L%+1: K%=K%+1: GOTO 1850        'move down one line
1130    K%=K%+1: GOSUB 460: COLOR 7,0: LOCATE 24,79: PRINT:
        GOSUB 490: GOTO 1860                             'scroll up at bottom

1140    IF Q%<>272 THEN 1180                             'up a line
1150    IF K%<=1 THEN 1870                               'skip if first
1160    IF L%>1 THEN L%=L%-1: K%=K%-1: GOTO 1850         'move up one line
1170    X%=X%-1: GOTO 1810                               '

1180    IF Q%<>281 THEN 1210                             'down a page
1190    IF K%-L%>RL-26 THEN X%=INT(RL/24)*24+1:GOTO 1810  'on last page
1200    X%=K%-L%+25: GOTO 1810                           'next page

1210    IF Q%<>273 THEN 1240                             'up a page
1220    IF K%-L%<24 THEN X%=1: GOTO 1810                 'on first page already
1230    X%=K%-L%-23: GOTO 1810                           'previous page
```

```
1240    IF Q%=271 THEN X%=1: GOTO 1810                   'first page
1250    IF Q%=279 THEN X%=INT(RL/24)*24+1: GOTO 1810     'last page
        '
1260    IF M%<5   THEN 1450                              'skip interpret
        '
1270    IF Q%=45 THEN MID$(A$,K%)=N$: B1%=1: GOTO 1720   'null
1280    IF Q%=84 THEN MID$(A$,K%)=T$: B1%=1: GOTO 1720   'text
1290    IF Q%=66 THEN MID$(A$,K%)=B$: B1%=1: GOTO 1720   'byte
1300    IF Q%=73 THEN MID$(A$,K%)=I$: B1%=2: GOTO 1720   'integer
1310    IF Q%=88 THEN MID$(A$,K%)=X$: B1%=2: GOTO 1720   'date 1970
1320    IF Q%=89 THEN MID$(A$,K%)=Y$: B1%=2: GOTO 1720   'date 1980
1330    IF Q%=83 THEN MID$(A$,K%)=S$: B1%=4: GOTO 1720   'sp real
1340    IF Q%=90 THEN MID$(A$,K%)=Z$: B1%=4: GOTO 1720   'date 1900
1350    IF Q%=68 THEN MID$(A$,K%)=D$: B1%=8: GOTO 1720   'dp real
        '
1360    IF Q%=330 THEN U$="-": GOTO 1660                 'all null
1370    IF Q%=220 THEN U$="t": GOTO 1660                 'all text
1380    IF Q%=248 THEN U$="b": GOTO 1660                 'all bytes
1390    IF Q%=223 THEN U$="i": GOTO 1660                 'all integer
1400    IF Q%=245 THEN U$="x": GOTO 1660                 'all date 1970
1410    IF Q%=221 THEN U$="y": GOTO 1660                 'all date 1980
1420    IF Q%=231 THEN U$="s": GOTO 1660                 'all sp reals
1430    IF Q%=244 THEN U$="z": GOTO 1660                 'all dates 1900
1440    IF Q%=232 THEN U$="d": GOTO 1660                 'all dp reals
                                                         -ON "ALT" KEYS-

1450    IF Q%=259 THEN 2220                              'F1 = HELP
1460    IF Q%=260 THEN CLS: CLOSE: KILL "D?.TMP": END    'F2 = END ****
1470    IF Q%=261 THEN CLOSE: CLS: GOTO 770              'F3 = DIR
1480    IF Q%=262 THEN CLOSE: GOTO 820                   'F4 = FILE
1490    IF Q%=263 THEN 950                               'F5 = A or D
1500    IF Q%=264 THEN 960                               'F6 = RECORD
1510    IF Q%=265 THEN A$="": GOTO 1010                  'F7 = Restart
1520    IF Q%=266 THEN AFLAG%=1-AFLAG%: GOTO 1680        'F8 = Toggle Accts/Mat
hs
1530    IF Q%=267 THEN M$="REPLACE RECORD ? (Y)": DE$="Y": GOSUB 320:
              IF Q$="Y" THEN PUT #1, RN%: GOTO 1050      'F9 = Save rec.
1540    IF Q%=268 THEN GOSUB 1890: GOTO 1050             'F10= PRINT

1550    IF M%=5 THEN 1870
1560    IF M%=4 THEN 1630
        '
        '********************* HEX$ EDIT
1570    IF Q%<48 OR (Q%>57 AND Q%<65) OR Q%>70 THEN 1870 'invalid hex$
1580    Q%=Q%-48: IF Q%>9 THEN Q%=Q%-7
1590    IF M%=2 THEN Q2%=1 ELSE Q2%=-1
1600    Q1% = SCREEN (CL%,CC%+Q2%,0)-48: IF Q1%>9 THEN Q1%=Q1%-7  'other nybble
1610    IF       M%=2
        THEN     MID$(R$,K%)=CHR$(Q%*16 + Q1%)
        ELSE     MID$(R$,K%)=CHR$(Q1%*16 + Q%)
1620    GOTO 1680                                        'HEX$ editor

        '********************* TEXT EDIT
1630    IF Q%<32 OR Q%>126 THEN 1870                     'invalid text
1640    MID$(R$,K%)=CHR$(Q%): GOTO 1680                  'TEXT editor

        '********************* REDISPLAY
1650    '***** Redisplay a page complete:
        K% = current byte: L% = current line.
1660    FOR A%=1 TO RL: IF (ASC(MID$(A$,A%)) AND LC%)>0 THEN MID$(A$,A%)=U$:
                 'substitute all non-u.c. characters with the given l.c.
1670    NEXT
1680    GOSUB 460: COLOR 7,0: CLS: M$="": L1%=L%: K1%=K%: X%=K%-L%+1: Y%=X%+23:
        IF Y%>RL THEN Y%=RL
1690    FOR      K%=X% TO Y%:
                 L%=K%-X%+1:   GOSUB 490:
        NEXT: L%=L1%: K%=K1%
1700    GOTO 1860                                        'cursor where it was.

1710    '***** Redisplay page from current byte to length of entry; curs down.
1720    GOSUB 460: COLOR 7,0: L1%=L%: K1%=K%: Y%=K%+B1%:
        IF Y%>K%-L%+24 THEN Y%=K%-L%+24
1730    IF Y%>RL THEN Y%=RL
1740    FOR      K%=K1% TO Y%:
                 L%=K%-K1%+L1%: GOSUB 490:
        NEXT: L%=L1%: K%=K1%: LOCATE L%,C%(M%): GOSUB 460

1750    IF B1%>RL-K% THEN B1%=RL-K%
1760    IF B1%<=0 THEN 1850
1770    FOR B%=1 TO B1%:
              IF L%<24 THEN L%=L%+1: K%=K%+1: GOSUB 460: GOTO 1790
1780          K%=K%+1: GOSUB 460: COLOR 7,0: LOCATE 24,79: PRINT : GOSUB 490
1790          LOCATE L%,C%(M%): GOSUB 460:
        NEXT: GOTO 1870                                  'cursor down b1%
```

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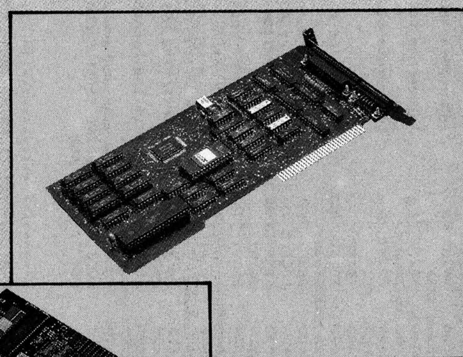

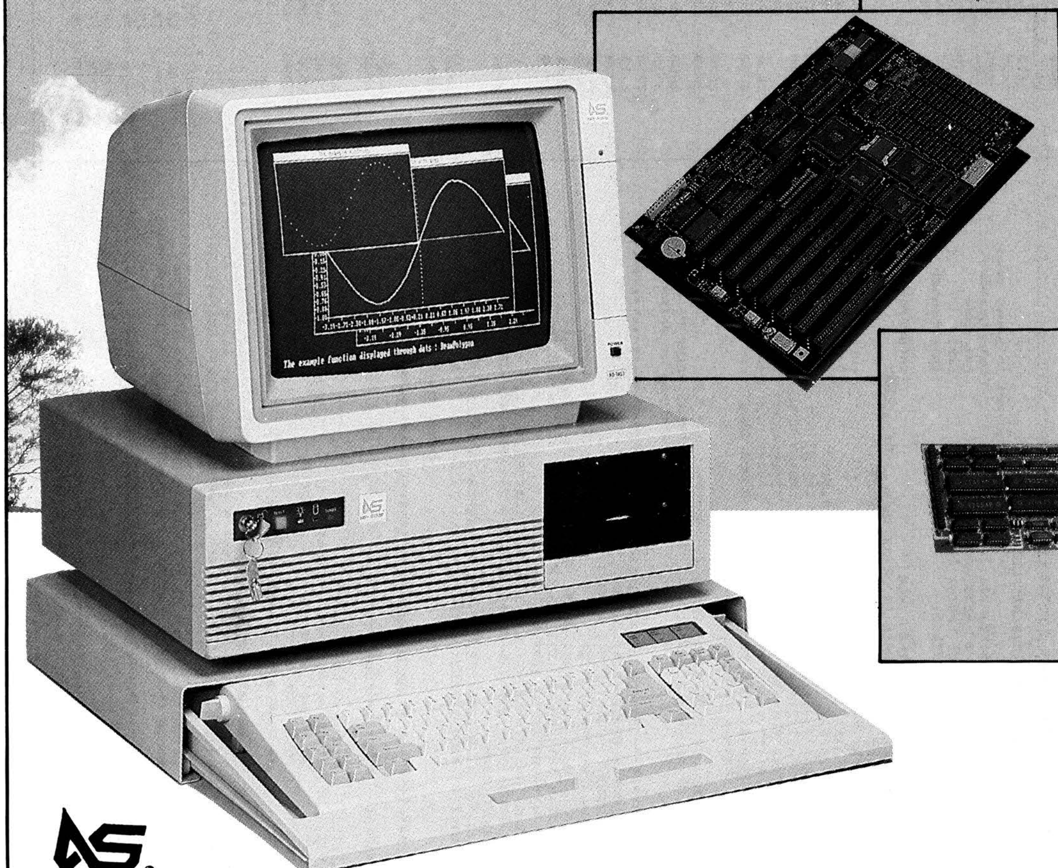

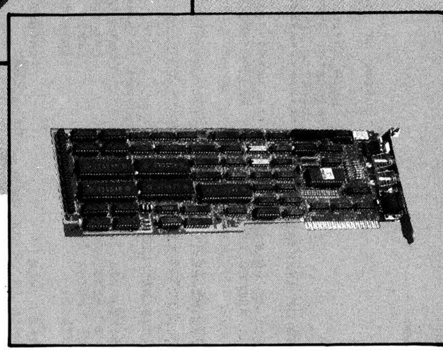

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```
1800    '***** Display a page:
         Starting at byte X% and going to end of screen (line 24) or end of
         record. L%=screen line: K%=byte no., X%=byte at start of page.
1810    GOSUB 460: COLOR 7,0: CLS: M$="": IF X%<1  THEN X%=1
1820    Y%=X%+23: IF Y%>RL THEN Y%=RL
1830    FOR K%=X% TO Y%:
                L%=K%-X%+1: GOSUB 490
1840    NEXT: L%=1: K%=X%:
        GOTO 1860                                      'cursor at top of scre
en
1850    GOSUB 460                                      'toggle curs off
1860    LOCATE L%,C%(M%): GOSUB 460                    'relocate, curs. on
1870    GOTO 1050                                      'back to input.
        *********************** END OF ANALYSIS ******************************
*
1880    '******************** OUTPUT TO PRINTER ****************************
1890    LPRINT "ANALYSIS OF ";FIL$;"; RECORD LENGTH ";RL;"; RECORD NO. ";RN%
1900    K1%=K%
1910    FOR K%=1 TO RL
1920    A1$=MID$(A$,K%,8): R1$=MID$(R$,K%,8):
        FOR A%=1 TO 8
1930            A1%=ASC(MID$(A1$,A%)):
                IF A1%>95 THEN MID$(A1$,A%)=CHR$(A1%-LC%)
1940    NEXT                                          'convert to upper case
1950    LPRINT TAB(C%(1)); MID$(STR$(K%),2);                   'byte number
1960    LPRINT TAB(C%(2)); RIGHT$(("0"+HEX$(ASC(R1$))),2);     'hex code
1970    LPRINT TAB(C%(4));:GOSUB 420: LPRINT CHR$(Q1%);        'text
1980    LPRINT TAB(C%(5)); MID$(A$,K%,1);                      'interpreter
1990    LPRINT TAB(C%(6));:
                IF LEFT$(A1$,1)=N$ THEN 2080                   'interpretation
2000            IF LEFT$(A1$,1)=T$ THEN IF Q%<32 THEN IF Q$(Q%)=""
                THEN LPRINT CHR$(Q%); ELSE LPRINT Q$(Q%);
                ELSE LPRINT CHR$(Q%);                          'text
2010            IF LEFT$(A1$,1)=B$ THEN LPRINT Q%;             'byte
2020            IF LEFT$(A1$,2)=I$ THEN LPRINT CVI(R1$);       'integer
2030            IF LEFT$(A1$,2)=X$ THEN GOSUB 2120: LPRINT DT$; 'date 1970 base
2040            IF LEFT$(A1$,2)=Y$ THEN GOSUB 2130: LPRINT DT$; 'date 1980 base
2050            IF LEFT$(A1$,4)=S$ THEN A=CVS(R1$): GOSUB 2090  'sp real
2060            IF LEFT$(A1$,4)=Z$ THEN GOSUB 2140: LPRINT DT$; 'date 1900 base
2070            IF LEFT$(A1$,8)=D$ THEN A=CVD(R1$): GOSUB 2090  'dp real
2080    NEXT: LPRINT: LPRINT: K%=K1%: RETURN                   '

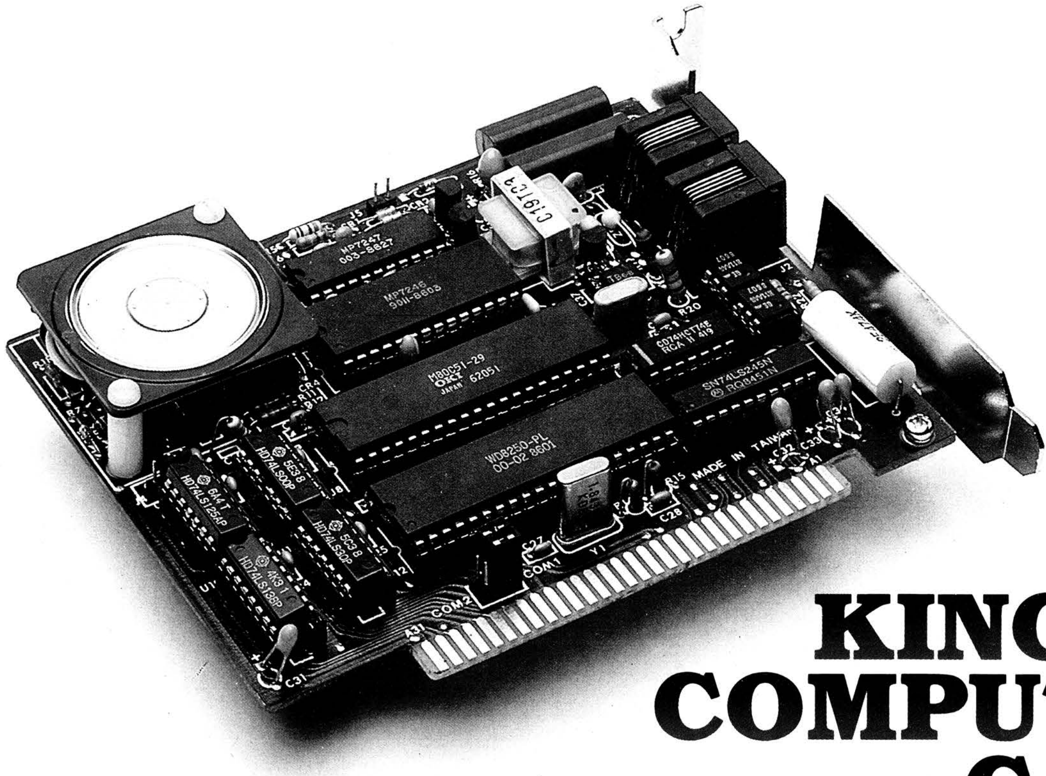
2090    IF AFLAG% THEN GOTO 2100 ELSE LPRINT A;: RETURN
2100    IF ABS(A)>A1 OR ABS(A)<A2 THEN LPRINT  "*"; ELSE LPRINT USING P$;A;:
        RETURN                                        'accounts or maths

2110    '********************** DATE TRANSLATION *****************************
2120    B5%=70: B6=10958: B7=CVI(R1$): GOTO 2150
2130    B5%=80: B6=7305:  B7=CVI(R1$): GOTO 2150
2140    B5%=0 : B6=36525!:B7=CVS(R1$)
2150    B9$=MO$: IF B7<0 OR ABS(B7)<1 OR B7<>INT(B7) OR B7>B6 THEN 2180
2160    B7%=INT(B7/365.25): B9%=B7-B7%*365-INT((B7%-1)/4):B7%=B7%+B5%:
        IF INT(B7%/4)*4=B7% THEN MID$(B9$,4)="9"
2170    B5%=0: B6%=1: WHILE B5%<B9%: B5%=B5%+VAL(MID$(B9$,B6%,2)): B6%=B6%+2:
        WEND: B8%=(B6%-1)/2: B9%=VAL(MID$(B9$,B6%-2,2))-B5%+B9%: GOTO 2190
2180    DT$="*": GOTO 2200
2190    DT$=RIGHT$("0"+MID$(STR$(B9%),2),2)+"-"+RIGHT$("0"+MID$(STR$(B8%),2),2)
        +"-"+RIGHT$("0"+MID$(STR$(B7%),2),2)
2200    RETURN                                        'date function

2210    '********************** HELP PAGES **********************************
2220    CLS
2230    PRINT TAB(33);"FUNCTION KEYS"
2240    PRINT
2250    PRINT "F1        Displays these pages
2260    PRINT "F2        Closes file; ends program.
2270    PRINT "F3        To select alternative directories
2280    PRINT "F4        To select a new file
2290    PRINT "F5        To dump a section of file to the printer in hex or text
or both
2300    PRINT "F6        To select another record from the file
2310    PRINT "F7        To clear the interpretation to its initial state
2320    PRINT "F8        Toggles between accounting and mathematical interpretati
on for reals
2330    PRINT "F9        Saves the record on the screen (with any changes made)
2340    PRINT "F10       Sends the whole record to printer. (use PrtSc for screen
only)
2350    LOCATE 25,33:PRINT "**** PRESS A KEY ****";: Q$=INPUT$(1): CLS
2360    PRINT TAB(33);"INTERPRETATIONS
2370    PRINT
2380    PRINT "T         Interprets the adjacent byte as text
2390    PRINT "B         Interprets the adjacent byte as a byte value (0 - 255)
2400    PRINT "I         Interprets two bytes as an integer (-32676 to 32767)
2410    PRINT "X         Interprets two bytes as an integer date; days from 01-01
-70 to 2000
2420    PRINT "Y         Interprets two bytes as an integer date; days from 01-01
-80 to 2000
2430    PRINT "S         Interprets four bytes as an sp real in maths or accts. r
anges (F8)
2440    PRINT "Z         Interprets four bytes as an sp real date; days from 01-0
1-00 to 2000
2450    PRINT "D         Interprets eight bytes as a dp real in maths or accts. r
anges (F8)
2460    PRINT
2470    PRINT "ALT-      with any of the above interprets all bytes in the record
 as described
2480    PRINT "F7        restores to the default interpretation
2490    LOCATE 25,33:PRINT "**** PRESS A KEY ****";: Q$=INPUT$(1): CLS
2500    PRINT TAB(33);"OTHER FUNCTIONS
2510    PRINT
2520    PRINT "The cursor control keys, also Home, End, Pg Up, Pg Down, act as e
xpected.
2530    PRINT "The cursor can move left and right between the HEX column, the TE
XT column
2540    PRINT "and the interpreter column.
2550    PRINT
2560    PRINT "You can edit the record by changing the characters in the HEX and
 TEXT columns
2570    PRINT "and save your changes with F10.
2580    LOCATE 25,33:PRINT "**** PRESS A KEY ****";: Q$=INPUT$(1): CLS
2590    M$="": GOTO 1680
        '

2600    '************************ DATA DUMP ********************************
2610    CLS: COLOR 0,7: PRINT "DATA DUMP ON: ";FIL$: COLOR 7,0: PRINT
2620    LOCATE 5,1: INPUT "Start at record : ",Q$: IF Q$="" OR VAL(Q$)<1
        OR VAL(Q$)>NR% THEN M$="Invalid Record Number": GOSUB 300: GOTO 2620
2630    START%=VAL(Q$)
2640    LOCATE 7,1: INPUT "End   at record : ",Q$: IF Q$="" OR VAL(Q$)<1
        OR VAL(Q$)>NR% THEN M$="Invalid Record Number": GOSUB 300: GOTO 2640
2650    FIN%=VAL(Q$)
2660    LOCATE 9,1:INPUT "Do you want Text, or Hex, or Both? (T/H/B) :",Q$:
        IF Q$="" THEN 2660
2670    Q$=CHR$(ASC(Q$) AND 95): IF Q$<>"T" AND Q$<>"H" AND Q$<>"B" THEN 2660
2680    LOCATE 11,1: PRINT "Press any key to stop....
2690    OPEN "R",#1,FIL$,RL: FIELD #1, RL AS R$
2700    LPRINT CHR$(15): WIDTH "LPT1:",PW1            'condensed print on
2710    LPRINT "DUMP on file:   ";FIL$
2720    LPRINT "Record length = ";RL
2730    LPRINT "Start at byte   ";(START%-1)*RL+1
2740    LPRINT
2750    FOR J%= START% TO FIN%: J$=INKEY$: IF J$<>"" THEN J%=FIN%: GOTO 2850
2760            GET #1,J%: IF Q$="T" THEN 2800
2770            LPRINT LEFT$(STR$(J%)+BL$,7);:
                FOR K%= 1 TO RL:
                        B%=ASC(MID$(R$,K%))
2780                    HX$=RIGHT$(("0"+HEX$(B%)),2)+" ":
                        LPRINT HX$;:
                NEXT: LPRINT
2790            IF Q$="H" THEN 2830
2800            LPRINT LEFT$(STR$(J%)+BL$,7);:
                FOR K%= 1 TO RL:
                        B%=ASC(MID$(R$,K%))
2810                    IF B%<32 OR B%>126 THEN B%=46
2820                    LPRINT CHR$(B%);"  ";:
                NEXT: LPRINT
2830    IF (J%-START%+1) MOD 24 = 0 AND Q$="B" THEN LPRINT CHR$(12): GOTO 910
2840    IF (J%-START%+1) MOD 48 = 0 THEN LPRINT CHR$(12)       'form feed here
2850    NEXT J%
2860    LPRINT CHR$(12): LPRINT CHR$(18): WIDTH "LPT1:",PW2: CLOSE: GOTO 950
        'END of DUMP

2870    '************ ERROR TRAP ************
2880    IF ERR=75 OR ERR=76 AND ERL=840 THEN CLS: D%=0: RESUME 770
2885    IF ERR=76 AND ERL=686 THEN BEEP: RESUME 682
2890    IF ERR=53 AND ERL=840 THEN M$="No such file!": GOSUB 300: RESUME 820
2900    IF ERR=55 AND (ERL=990 OR ERL=2690) THEN CLOSE: RESUME
2910    IF ERR=5 AND ERL=500 THEN RESUME 510
2920    IF ERR=5 AND ERL=1930 THEN RESUME 1940
2930    ON ERROR GOTO 0
```



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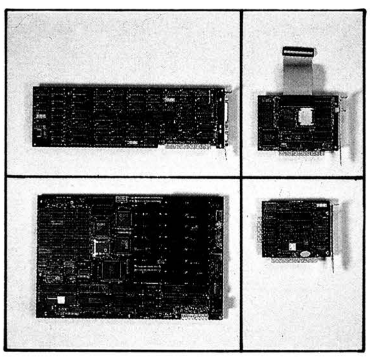

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Commodore 1541 Disk Utilities

by C Whitfield

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *66637#

This program should work with any Commodore computer and a 1541 disk drive. Its purpose is to simplify disk housekeeping to make free blocks usable and speed up the directory listing. The program has been tested on the C64 and Plus/4, and should work on all other Commodore machines with 2031, 4040 or even 1571 (C64 format only) disk drives.

The program is fully menu-driven and self-explanatory. Most sections simply emulate the commands that would usually be typed-in to perform a function. The exceptions are disk rename and the directory. The disk rename works by doing the equivalent of a POKE directly to the disk via one of the RAM buffers inside it. It isn't possible to change the disk ID using this routine. The directory routine works by PEEKing at the contents of the directory via a RAM buffer.

All the REMs can be omitted when typing-in the program. To stop the program, press RUN/STOP.

```
1   54 48 41 5A 4C 45 54 54 20 20 20 20 20 20 20 20 20 20 20 57 20 53 20 20 20 20 20 20 4D 51 32 35
1   T  H  A  Z  L  E  T  T                                      W     S                    M  Q  2  5
2   30 38 20 20 20 20 30 39 30 20 20 20 00 68 70 8E 00 AC 71 8F 48 4D 37 37 34 38 33 30 44 41 59 01
2   0  8              0  9  0           .  h  p  .  .  .  q  .  H  M  7  7  4  8  3  0  D  A  Y  .
3   48 20 00 00 3C 0F 78 83 17 82 95 65 08 7F D7 A3 60 83 48 59 24 84 57 00 00 74 00 00 00 00 00 00
3   H     .  .  <  .  {  .  .  .  .  e  .  .  .  .  .  .  H  Y  $  .  W  .  .  t  .  .  .  .  .  .
4   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 7F 02 00 03 00 00 00 00 00 33 00 19 00
4   .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  3  .  .  .
5   00 00 00 00 00 00 74 00 00 00 00 00 00 00 74 00 00 00 36 00 00 00 36 00 00 00 36 00 00 00 48 00
5   .  .  .  .  .  .  t  .  .  .  .  .  .  .  t  .  .  .  6  .  .  .  6  .  .  .  6  .  .  .  H  .
6   00 00 48 00 41 00 20 20 8A B8 1E 17 86 00 00 00 00 20 00 00 48 00 00 00 48 00 00 00 48 00 20 00
6   .  .  H  .  A  .        .  .  .  .  .  .  .  .  .     .  .  H  .  .  .  H  .  .  .  H  .     .
7   00 48 00 00 00 48 00 00 00 48 00 00 C0 18 88 00 00 7A 8A 00 00 48 00 00 00 00 00 04 00 00 00 00
7   .  H  .  .  .  H  .  .  .  H  .  .  .  .  .  .  .  z  .  .  .  H  .  .  .  .  .  .  .  .  .  .
8   00 00 00 00 4A 53 91 00 00 00 00 52 08 54 8C 00 00 28 85 4E 33 00 00 00 00 00 00 00 C3 F5 61 87
8   .  .  .  .  J  S  .  .  .  .  .  R  .  T  .  .  .  (  .  N  3  .  .  .  .  .  .  .  .  .  a  .
9   7B 00 A4 30 2F 89 7F 00 EC 51 37 86 80 00 F6 28 65 86 7D 00 48 E1 46 85 7E 00 1F E5 17 87 7C 00
9   {  .  .  0  /  .  .  .  .  Q  7  .  .  .  .  (  e  .  }  .  H  .  F  .  ^  .  .  .  .  .  |  .
10  33 33 63 82 82 00 07 A3 60 84 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
10  3  3  c  .  .  .  .  .  `  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
11  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
11  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
12  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
12  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
```

Fig 1

Fig 2

```
43  20       T
44  20       T
45  00   .   Z   15-02-42
46  68   h   Z   *
47  70   p   Z   *
48  8E   .   Z   *
49  00   .   Z   10-03-84
50  AC   .   Z
51  71   q   Z
52  8F   .   Z
53  48   H   T   H
54  4D   M   T   M
55  37   7   T   7
56  37   7   T   7
57  34   4   T   4
58  38   8   T   8
59  33   3   T   3
60  30   0   T   0
61  44   D   T   D
62  41   A   T   A
63  53   Y   T   Y
64  01   .   B    1
65  48   H   T   H
66  20       T
|1 HELP|2 END |3 PATH|4 FILE|5 DUMP|6 REC |7 CLEAR|8 ACCT|9 SAVE|10 PRINT|
```

```
10 REM ****************
20 REM *DISK UTILITIES*
30 REM *BY C.WHITFIELD*
40 REM * ------------ *
50 REM * MODIFIED BY: *
60 REM * ROSS SKINNER *
70 REM *     1986     *
80 REM ****************
90 REM *** ALL REM LINES CAN BE MISSED
100 REM *** DON'T PUT A SPACE BETWEEN 'DRIVE' AND 'NUMBERS' ON LINE 1020
110 POKE53280,0:POKE53281,0:PRINT"[LG]"
120 V=8:D=0:D$="0"
130 REM *** MAIN SECTION
140 PRINT"[CLS]"
150 PRINT"[CD][CD]PRESS APPROPRIATE KEY TO SELECT OPTION"
160 PRINT"[CD]PRESS NUMBER KEYS TO CHANGE DEVICE/DRIVENUMBERS"
170 PRINT"[CD]C - COMPACT DIRECTORY"
180 PRINT"D - DIRECTORY"
190 PRINT"F - FORMAT"
200 PRINT"R - RENAME A FILE"
210 PRINT"S - SCRATCH A FILE"
220 PRINT"T - RENAME DISK"
230 PRINT:PRINT
240 PRINT"[CR][CR][CR][CR][CR][CR][CR][CR][CR][CR][CR][CR][CR][CR]DEVICE NUMBER
="|V
250 PRINT
260 PRINT"[CR][CR][CR][CR][CR][CR][CR][CR][CR][CR][CR][CR][CR][CR]DISK NUMBER
=";D
270 GETA$:IFA$=""THEN270
280 IFA$="C"THEN400
290 IFA$="D"THEN420
300 IFA$="F"THEN690
310 IFA$="R"THEN810
320 IFA$="S"THEN890
330 IFA$="T"THEN990
340 IFA$="8"THENV=8:GOTO140
350 IFA$="9"THENV=9:GOTO140
360 IFA$="0"THEND$="0":D=0:GOTO140
370 IFA$="1"THEND$="1":D=1:GOTO140
380 GOTO 140
390 REM *** COMPACT (VALIDATE)
400 PRINT"[CLS]COMPACTING NOW.":OPEN15,V,15,"V"+D$:CLOSE15:GOTO140
410 REM *** DIRECTORY
420 PRINT"[CLS]"
430 OPEN1,V,0,"$"+D$
440 FORA=1TO29
450 GET#1,A$
460 IFA$=""THEN450
470 IFASC(A$)<32ORASC(A$)>128THEN490
480 PRINTA$;
490 NEXT:PRINT
500 FORB=1TO21
510 GET#1,A$
520 IFA$=""THEN510
530 IFST<>0THENCLOSE1:GOTO650
540 IFASC(A$)<32ORASC(A$)>128THEN570
550 PRINTA$;
560 NEXT
570 GET#1,A$:IFA$=""THEN570
580 IFST<>0THENCLOSE1:GOTO650
590 IFASC(A$)<>34 THEN 570
600 GET#1,A$:IFA$=""THEN600
610 IFST<>0THENCLOSE1:GOTO650
620 IFA$=" "THEN570
630 PRINT:PRINTCHR$(34);A$;
640 GOTO500
650 PRINT:PRINT"PRESS ANY KEY."
```

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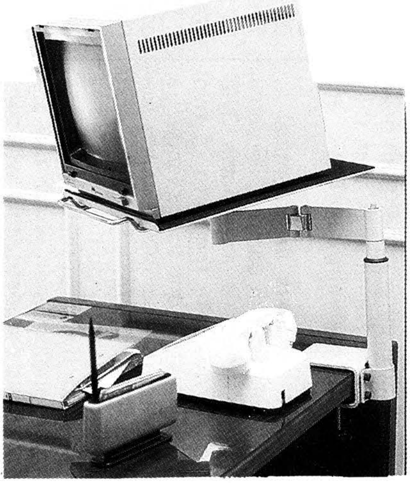

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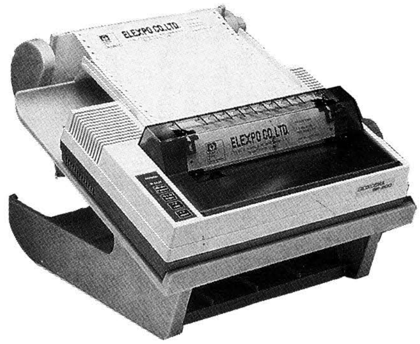

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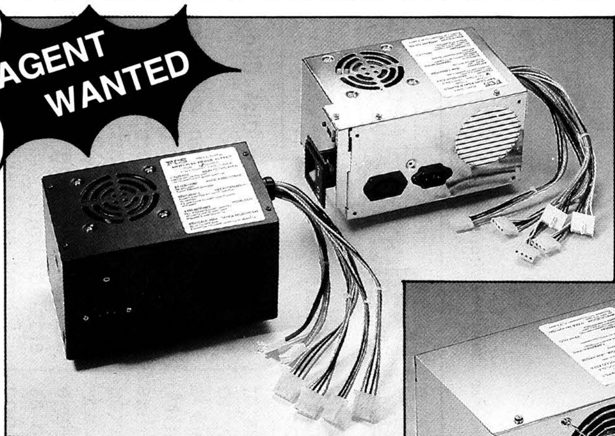

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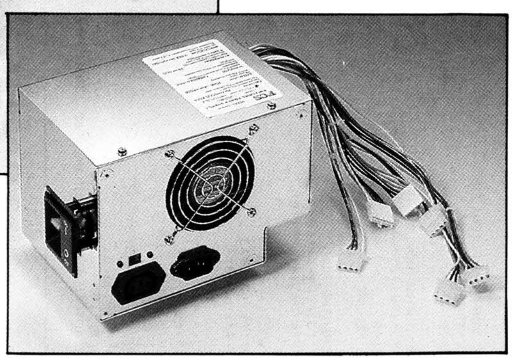

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```
660 GETB$:IFB$=""THEN660
670 GOTO140
680 REM *** FORMAT
690 GOSUB1130
700 INPUT"NEW ID";I$
710 IFLEN(I$)>2THENPRINT" ID TOO LONG ":GOTO700
720 PRINT"ARE YOU SURE ? (Y/N)"
730 GETA$:IFA$=""THEN730
740 IFA$="Y"THEN760
750 IFA$="N"THEN140:GOTO730
760 PRINT"FORMATTING NOW"
770 OPEN15,V,15,"N"+D$+":"+N$+","+I$
780 CLOSE15
790 GOTO 140
800 REM *** FILE RENAME
810 INPUT"[CLS]OLD NAME";O$
820 IFLEN(O$)>16THENPRINT"[CD]NAME TOO LONG[CD]":INPUT"OLD NAME";O$:GOTO820
830 GOSUB1140
840 PRINT"[CD]RENAMING NOW":FORI=1TO1000:NEXT
850 OPEN25,V,15,"R"+D$+":"+N$+"="+O$
860 CLOSE15
870 GOTO 140
880 REM *** SCRATCH
890 INPUT"[CLS]FILE TO BE SCRATCHED";S$
900 IFLEN(S$)>16THENPRINT"[CD]TOO LONG":INPUT"[CD]FILE TO BE SCRATCHED";S$:GOTO9
00
910 PRINT"[CD]ARE YOU SURE (Y/N) ?"
920 GETA$:IFA$="Y"THEN950
930 IFA$="N"THEN140
940 GOTO920
950 PRINT"[CD]SCRATCHING NOW."
960 OPEN15,V,15,"S"+D$+":"+S$
970 CLOSE15:GOTO140
980 REM *** DISK RENAME
990 GOSUB1130
1000 PRINT"[CD]RENAMING NOW."
1010 B$="":FORL=1TO18:B$=B$+CHR$(160):NEXTL
1020 C$=LEFT$(LEFT$(N$,16)+B$,18)
1030 OPEN15,V,15
1040 OPEN5,V,5,"#"
1050 PRINT#15,"U1:";5;D;18;0
1060 PRINT#15,"B-P";5;144
1070 PRINT#5,C$;
1080 PRINT#15,"U2:";5;D;18;0
1090 PRINT#15,"I"+D$
1100 CLOSE5:CLOSE15
1110 GOTO 140
1120 REM *** NAME INPUT ROUTINE
1130 PRINT"[CLS]"
1140 INPUT"NEW NAME";N$
1150 IF LEN(N$)>16 THEN PRINT"[CD]NAME TOO LONG[CD]":GOTO1140
1160 RETURN
```

BBC ROM Header

by David McKay

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *66637#.

One of the more powerful features of the BBC machines is their ability to support paged ROM software. This is 6502 machine code held in ROM, EPROM or sideways RAM, which has been assembled to run in the area &8000 to &BFFF. The operating system can handle up to 16 of these ROMs, although the motherboard as it stands can only take four. Only one ROM is paged-in at a time. The most common of these is Basic, followed by, probably, the disk filing system (DFS).

These ROMs can either provide a new environment (programming language, word processor, machine code monitor, and so on), an additional set of operating system commands (disk filing system, debugging aids), or both.

Paged software presents the user with the ability to write his own set of routines and store them on disk to be loaded into sideways RAM or to blow as his own EPROMs. This means that the commands added are always available and do not encroach on any of the precious 32k BBC owners get by on. But for the ROM to be recognised and treated as such, it must conform to certain protocols and function under certain criteria laid down by Acorn.

To illustrate this, presented here is a program which will generate the header for any service ROM. This is a ROM which provides, DFS-like, a new set of * commands. By inserting your own ROM name, copyright messages, and so on, the program is easily customised. Also included are routines to demonstrate how the ROM can cater for *HELP and *'command' requests. These are handled intelligently, the routines accepting either form of request in upper, lower or a combination of cases, with or without an abbreviation.

Two trivial commands are included to show you how they are implemented. These are: *POP, which gives a little bleep; and *HOME, which sends the cursor to the top-left corner of the screen without clearing the display. (These commands are the same as Basic's VDU 7 and VDU 30 respectively; they are for purposes of illustration rather than power, but one advantage is that they can be issued from non-Basic environments.)

All ROM headers are identical in format but differ in content, as you'll see. The format is as follows. The first six bytes take the form of two JMP statements: one to the language entry point of the ROM, which we don't deal with here; and the second to the service entry point.

The next byte specifies the ROM type, depending upon which bits are set; for our purposes, this will contain &82. This is because bit one must be set, which gives &02, and bit seven is set to signify that the ROM has a service entry. This gives &80, and added they give &82. If bit six were set, the ROM would have a language entry too (this byte would contain &C2).

Byte seven holds an offset that points from &8000 to the byte containing zero which precedes the copyright message. Byte eight contains a version number, which doesn't do anything apart from inform people which version of the ROM they are examining.

The title of the ROM is held from byte nine onwards, in ASCII, terminated by a zero byte. Right behind this comes (if there is one at all) a version string, a literary equivalent of the version number. This is followed by a zero byte and the copyright string. Due to the various lengths of the preceding strings, the location of this is going to differ from ROM to ROM; hence the need for an offset held in a known address that the operating system can look-up, then use to find the copyright string.

This is important because there must be a copyright string, even if it's the minimum (C). If these characters are omitted, the ROM is not recognised as a valid ROM. The copyright string usually has something like '(C) Dr Dupree 1986'; the message is terminated by a zero byte. If there's going to be a second processor relocate address, it would follow-on here, but we won't need one. They are for languages which need to be copied across to a specific address in the second processor.

Unrecognised operating system commands are offered to the paged ROMs in order of priority (&0F down to &00) and if the command is still unclaimed, then the disk is searched for a file of that name. The command is stored at a location pointed to by &F2 and &F3, plus an offset held in the Y register. The ROM is given a

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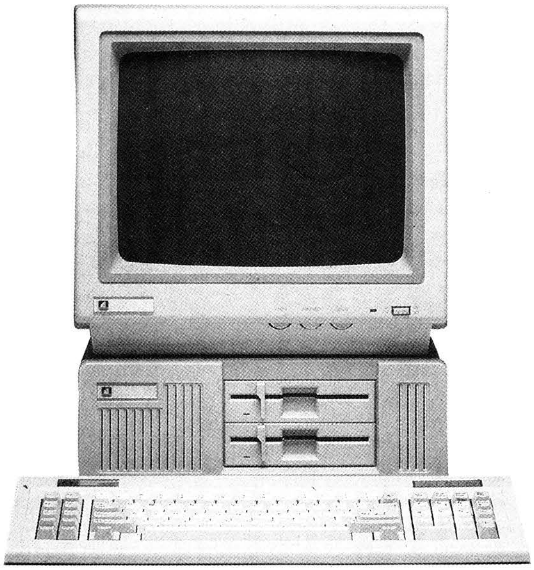

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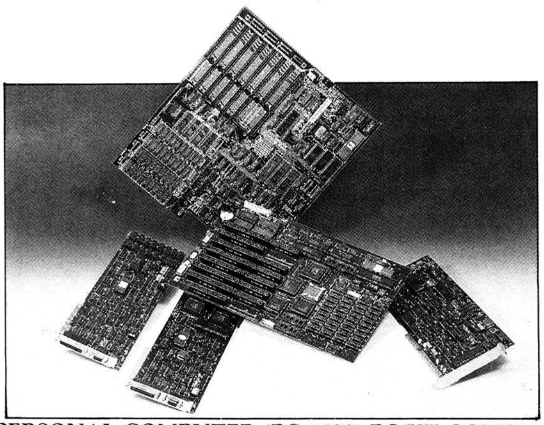

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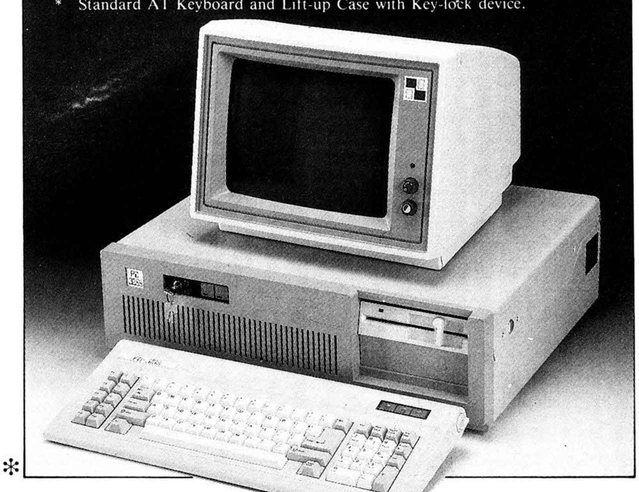

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service call with &04 in the accumulator. It then scans the command and compares it with the commands it responds to. It either performs the function and exits, telling the other ROMs that the command has been dealt with (by storing &00 in A), or exits and passes the chance of execution to the next ROM down the line.

*HELP causes a similar service call, with &09 in the accumulator. The ROM must print out its name and, by convention, another word (or pair of words for some ROMs) slightly indented from the left margin that the ROM can give further help on. The service call is then passed on down to the next ROM. Some ROMs of course, don't offer any further help, and just print their name.

If it's a specific *HELP request, asking for help from one, and only one, ROM — for example, *HELP DFS, then the ROM can do one of three things. If the request is for another ROM, it can pass the request on; if it's for itself, it must give the extra help then stop the service call going to other ROMs; or it can print out its name as before and pass on the call. The program as set up does the latter.

The code is assembled at &4000 as if it were being assembled at &8000. The service call causes control to JMP to CHECK, where the accumulator is examined. If it contains &04, the commands are examined; if it contains &09, the help check routine is used. If it's neither, control is passed back to the operating system with the accumulator intact, ready for the next ROM.

The help-checking routine is entered at HLPCH, saves the registers and checks to see if the request was for this ROM, printing either a small help or large help output. The registers are restored and the ROM exited, with either the accumulator intact or zeroed, depending on the action performed by the ROM.

The command check functions similarly, deciding whether the request is to be performed by this ROM, getting the address of the command location if it is, and JMPing to it. The ROM is then exited with the accumulator set to zero. Otherwise, the service call is passed on.

The commands are stored in a table, with the ASCII command followed by the high byte and low byte of the address at which the code that executes the command is located. This is set up automatically by the program. The bottom of the table is marked by &FF, a pseudo-negative byte. New commands are easily added in the format shown, inserting the name and address bytes, referenced by the label that you used for the location at which the command code resides. If this sounds fierce, just look at the program: it really is easy.

The program is liberally commented and spaced out, but you can leave out the comments when you type it in. Put in the title you want, and alter the HELP tables to give the details you need.

When RUN, the program generates the necessary 6502 code header and then *SAVEs it under a filename you've been previously prompted for. You are told the length of the code, and reminded that *LOAD filename 8000 will insert it into the sideways RAM. The code, if it performs correctly without debugging, is ready to be blown into an EPROM.

```
10    REM  ROM HEADER CODE
20    MODE 7
30    PRINT:INPUT "Filename for ROM CODE "FL$
40    FOR PASS=4 TO 6 STEP 2
50    O%=&4000:P%=&8000
60    [OPT PASS
70    .LANG     EQUW &0000
80              EQUB &00          ;NO LANGUAGE ENTRY
90    .SERV     JMP CHECK         ;SERVICE ENTRY
100   .TYPE     EQUB &82          ;COMMANDS ONLY
110   .OFST     EQUB HERE-LANG
120   .VERNO    EQUB &01
130   .TITLE    EQUS "DEMOROM"
140             EQUB &00
150   .VERSTR   EQUS "DEMO ROM VERSION 1.0"
160   .HERE     EQUB &00
170   .COPYRT   EQUS "(C) copyright message"
180             EQUS " MUST have the bracketed"
190             EQUS " capital C at least."
200             EQUB &00
210   .CHECK    CMP #&04          ;IS IT A COMMAND
220             BNE HPCH          ;NO, IS IT A HELP
230             JMP COMCH         ;YES, CHECK COMMAND LIST
240   .HPCH     CMP #&09          ;IS IT A HELP REQUEST
250             BNE OUT           ;NO, SO LEAVE ROM
260             JMP HLPCH         ;YES, CHECK IF FOR THIS ROM
270   .OUT      RTS               ;ROM EXIT
280   .HLPCH    PHP
290             PHA
300             TXA               ;SAVE REGISTERS
310             PHA
320             TYA
330             PHA
340             LDX #&00
350   .BLOOP    LDA (&F2),Y
360             CMP TITLE,X       ;CHECK REQUEST AGAINST
370             BEQ NXLET         ;TITLE, CATER FOR LOWER
380             SEC               ;CASE LETTERS
390             SBC #&20
400             CMP TITLE,X
410             BNE SMALL         ;NOT THIS ROM, PRINT
420   .NXLET    INX               ;NAME ONLY
430             INY
440             LDA (&F2),Y
450             CMP #&2E          ;CATER FOR ABBREVIATIONS
460             BEQ LARGE
470             CPX #&05
480             BCC BLOOP
490   .LARGE    LDX #&00
500   .LLOOP    LDA BTEXT,X       ;PRINT FULL HELP
510             CMP #&00
520             BEQ BOUT
530             JSR &FFE3
540             INX
550             JMP LLOOP
560   .SMALL    LDX #&00
570   .SLOOP    LDA LTEXT,X       ;PRINT SMALL HELP
580             CMP #&00
590             BEQ LOUT
600             JSR &FFE3
610             INX
620             JMP SLOOP
630   .BOUT     PLA
640             TAY
650             PLA               ;RESTORE REGISTERS
660             TAX               ;FORBID OTHER ROMS
670             PLA               ;FROM RESPONDING
680             PLP
690             LDA #&00          ;BY SETTING A TO ZERO
700             RTS
710   .LOUT     PLA
720             TAY
730             PLA               ;RESTORE REGISTERS
740             TAX               ;OFFER HELP REQUEST
750             PLA               ;TO THE OTHER ROMS
760             PLP               ;BY NOT ALTERING A
```

```
 770          RTS
 780 .BTEXT   EQUB &0D
 790          EQUS "DEMOROM - new * commands"
 800          EQUB &0D
 810          EQUS "  HOME"
 820          EQUB &0D
 830          EQUS "  POP"
 840          EQUB &0D
 850          EQUB &00
 860 .LTEXT   EQUB &0D
 870          EQUS "DEMOROM 1.0"
 880          EQUB &0D
 890          EQUS "  DEMOROM"
 900          EQUB &0D
 910          EQUB &00
 920 .LOCHK   LDA COMLIST,X    ;ROUTINE TO CATER FOR
 930          CLC              ;LOWER CASE LETTERS
 940          ADC #&20
 950          CMP (&F2),Y
 960          BEQ CLOOP
 970          JMP BACKUP
 980 .COMCH   PHA              ;COMMAND CHECK
 990          TXA
1000          PHA
1010          TYA
1020          PHA
1030          STY &0A02        ;SAVE Y OFFSET
1040          LDX #&FF
1050 .GRABY   LDY &0A02
1060          DEY
1070 .CLOOP   INY
1080          INX
1090          LDA COMLIST,X    ;CHECK COMMAND LIST
1100          BMI NEG          ;IS IT AN ADDRESS
1110          CMP (&F2),Y
1120          BNE LOCHK        ;IS IT LOWER CASE
1130          JMP CLOOP
1140 .BACKUP  INX
1150          LDA COMLIST,X
1160          BPL BACKUP
1170          INX
1180          LDA (&F2),Y
1190          CMP #&2E         ;CATER FOR ABBREVIATIONS
1200          BNE GRABY
1210          INY
1220          DEX
1230          LDA COMLIST,X
1240          BNE GRABADD
1250 .NEG     CMP #&FF         ;BOTTOM OF COMMAND LIST
1260          BEQ BYE          ;YES, SO EXIT
1270 .GRABADD STA &0A01
1280          LDA COMLIST+1,X ;ELSE LOAD ADDRESS
1290          STA &0A00
1300          JSR EXEC         ;AND GOTO COMMAND CODE
1310          CLC
1320 .BYE     PLA
1330          TAY
1340          PLA
1350          TAX
1360          PLA
1370          BCS HOP          ;IF COMMAND PERFORMED THEN
1380          LDA #&00         ;STOP OTHER ROMS RESPONDING
1390 .HOP     RTS
1400 .EXEC    JMP (&0A00)
1410 .COMLIST EQUS "HOME"      ;SET UP HOME COMMAND
1420          EQUB HOME DIV 256
1430          EQUB HOME MOD 256
1440          EQUS "POP"       ;SET UP POP COMMAND
1450          EQUB POP DIV 256
1460          EQUB POP MOD 256
1470          EQUB &FF         ;BOTTOM OF LIST MARKER
1480 .HOME    LDA #30          ;CODE FOR HOME
1490          JMP &FFE3
1500 .POP     LDA #&07         ;CODE FOR POP
1510          JMP &FFE3
1520          ]
1530 NEXT PASS
1540 OSCLI "*SAVE "+FL$+" 4000+"+STR$~(O%-&4000)
1550 PRINT' FL$:" saved. Code length=&";~(O%-&4000);" bytes."''
1560 PRINT "*LOAD ";FL$;" 8000 will load it into"
1570 PRINT "sideways RAM to behave as a ROM."
```

Amstrad CPC Crimebusters

by E Covell

This is a whodunnit game for two to six players. You have to solve a murder at Strangeways Hall which occurred in conjunction with an armed robbery. Each player has to identify the murderer, his/her accomplice, the stolen object, the murder weapon, and the room in which the crime was committed.

The building has two floors, each with several rooms. Some of the doors are locked and others not. At the start of the game, the keys can be located in the pantry or the linen room.

It's the cook who has been murdered, and the cause of death will be revealed when you find the body. The game is a competitive one — the other crimebusters can unlock and lock doors on you, and also steal a key from you.

When you have all the answers to the murder, you must go to the room where the murderer is and accuse him/her. If you answer all the questions correctly, you'll win; if you fail to, you'll be eliminated from the game.

Players take turns and have to give a simple code to identify themselves in order to eliminate cheating. As the game is essentially one of logic, it's a good idea to use pen and paper to record discovered facts.

Note that the author's printer was configured to produce the '£' sign instead of the '#' sign (the Amstrad being a British machine).

```
10 DIM voice1(34),len1(34);vo(21),len(21);vot(15),lent(15),voiw(17),lenw(1
7),r$(14),r%(14),dr$(14,4);nr%(14,4),k%(23);check(14),place$(6,20)
15 SPEED KEY 255,255:REM dont include this line until the programme is debugged
and running satisfactorily
20 REM:Title screen & music
25 GOSUB 2310:GOSUB 1990
30 RANDOMIZE TIME
35 CLS: INPUT "Do you want instructions (y/n)";ins$:IF ins$<>"y"AND ins$<>"n" TH
EN 35
40 IF ins$="n"THEN 45 ELSE GOSUB 2460
45 BORDER 15:PAPER 2:INK 2,20:PEN 3:INK 3,6:CLS
50 WINDOW£1,18,40,6,22:PEN £1,3:PAPER£1,2:CLS£1
55 WINDOW£2,1,40,1,5:PAPER£2,1:INK 1,26:PEN £2,0:INK 0,1:CLS £2
60 WINDOW£6,14,17,6,25:PAPER£6,2:PEN£6,0:CLS£6
65 WINDOW£7,18,35,23,25:PAPER£7,2:PEN£7,0:CLS£7
70 WINDOW £3,1,17,6,9:PAPER £3,2:CLS £3:PEN £3,0:WINDOW £4,1,17,10,17:PAPER £4,2
:CLS £4:PEN £4,0:WINDOW £5,1,17,18,25:PAPER £5,2:CLS £5:PEN £5,0
75 DEF FNr(x)=INT(RND(1)*x)+1
80 GOSUB 580
85 CLS£2:PRINT £2,"Won't be long-setting up the game"
90 REM:initialisation
```

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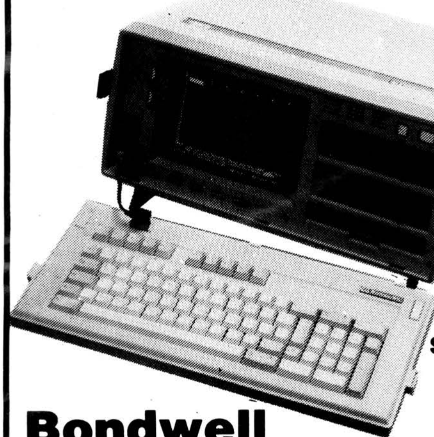

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```
95 p=FNr(8):m%=p
100 IF p>4 THEN fp$="woman's":fq$="man's":GOTO 110
105 fp$="man's":fq$="woman's"
110 p=FNr(7):sa%=p
115 p=FNr(4):IF m%<5 THEN a%=p+4 ELSE a%=p
120 FOR x=1 TO 3
125 p=FNr(8):IF d%(p)=1 THEN 125
130 d%(p)=1
135 NEXT
140 p=FNr(14):IF p=6 OR p=11 OR p=1 THEN 140
145 b%=p
150 x=1:FOR y=1 TO 14:check(x)=0:NEXT
155 WHILE x<4:p=FNr(14):IF p=6 OR p=11 THEN 155
160 IF check(p)<>0 THEN 155
165 w%(x)=p:check(p)=1: x=x+1
170 WEND
175 x=1: WHILE x<8
180 p=FNr(14):IF p=6 OR p=11 OR p=1 THEN 180
185 IF x=sa% THEN 195
190 v%(x)=p
195 x=x+1
200 WEND
205 x=1:WHILE x<9
210 p=FNr(14):IF p=6 OR p=11 OR p=1 THEN 225
215 s%(x)=p
220 x=x+1
225 WEND
230 x=1:WHILE x<7
235 p=FNr(12):IF k%(p)=6 THEN 245
240 k%(p)=6:x=x+1
245 WEND
250 FOR x=1 TO 12
255 IF k%(x)=0 THEN k%(x)=11
260 NEXT
265 p=FNr(14):IF p=6 OR p=11 OR p=1 THEN 265
270 k%(13)=p
275 FOR x=1 TO np%:pl%(x)=1:NEXT
280 FOR x=1 TO np%:pc%(x)=0:pf%(x)=0:NEXT
285  mw%=FNr(3)
290 IF mw%=1 THEN md$="SHOT"
295 IF mw%=2 THEN md$="CLUBBED TO DEATH"
300 IF mw%=3 THEN md$="STABBED"
305 x=1:fp%(mw%)=1:p$(mw%)=fp$
310 WHILE x<3
315 p=FNr(3):IF fp%(p)=1 THEN 315
320 IF x=1 THEN p$(p)=fp$
325 IF x=2 THEN p$(p)=fq$
330 fp%(p)=1
335 x=x+1:WEND
340 FOR x=1 TO 14:FOR y=1 TO 4:READ dr$(x,y):NEXT:NEXT
345  FOR x=1 TO 14:FOR y=1 TO 4:READ nr%(x,y):NEXT:NEXT
350 FOR x=1 TO 3:READ w$(x):NEXT
355 FOR x=1 TO 7:READ v$(x):NEXT
360 FOR x=1 TO 8:READ s$(x):NEXT
365 FOR x=1 TO 14:READ r$(x):NEXT
370 FOR x=1 TO 14:r%(x)=x:NEXT
375 FOR x=1 TO 14:check(x)=0:NEXT
380 sw(m%)=b%:sw(a%)=b%:IF m%<5 THEN qq=0 ELSE qq=4
385 x=1:WHILE x<4
390 y=FNr(4)+qq:IF sw(y)<>0 THEN 390
395 z=FNr(14):IF z=11 OR z=6 OR z=b% THEN 395
400 IF check(z)=1 THEN 395
405 check(z)=1:sw(y)=z:x=x+1
410 WEND
415 IF m%<5 THEN pp=4 ELSE pp=0
420 FOR x=1 TO 14:check(x)=0:NEXT
425 x=1:WHILE x<4
430 y=FNr(4)+pp:IF sw(y)<>0 THEN 430
435 p=FNr(4)+qq:IF sw(p)=b% THEN 435
440 IF check(sw(p))=1 THEN 435
445 check(sw(p))=1:sw(y)=sw(p):sk(p)=y:sk(y)=p:x=x+1
450 WEND
455 sk(m%)=a%:sk(a%)=m%
460 x=1
465 FOR y=1 TO 8:sk%(y)=0:NEXT:WHILE x<3
470 p=FNr(4):q=FNr(4):IF p=q THEN 470
475 IF sk%(p)<>0 OR sk%(q)<>0 THEN 470
480 sk%(p)=q:sk%(q)=p
485 x=x+1: WEND
490 x=1:WHILE x<3
495 p=FNr(4)+4:q=FNr(4)+4:IF p=q THEN 495
500 IF sk%(p)<>0 OR sk%(q)<>0 THEN 495
505 sk%(p)=q:sk%(q)=p
510 x=x+1
515 WEND
520 IF sw(sk%(m%))=sw(sk%(a%)) THEN 460
525 PEN 0: LOCATE 38,23:PRINT"N":LOCATE 37,24:PRINT"W";CHR$(159);"E":LOCATE 38,2
5:PRINT"S"
530 FOR x=1 TO 3
535 LOCATE £3,1,x:PRINT £3,x;w$(x)
540 NEXT
545 FOR x=1 TO 7
550 LOCATE £4,1,x:PRINT £4,x;v$(x)
555 NEXT
560 FOR x=1 TO 8
565 LOCATE£5,1,x:PRINT £5,x;s$(X)
570 NEXT
575 GOTO 650
580 GOSUB 1765:CLS£2:INPUT£2,"How many players,please (1 to 6)";np%
585 IF np%<0 OR np%>6 THEN 580
590 PRINT£2,"The computer will decide who goes first"
595 GOSUB 1765:INPUT£2,"How many questions to be allowed on any one turn(max 5)"
;nqr
600 IF nqr<0 OR nqr>5 THEN 595
605 FOR x=1 TO np%
610 GOSUB 1765:CLS£2:PRINT£2,"Player number";x:INPUT£2,"Please type your name (m
ax 8 letters)",in$(x)
615 pn$(x)=UPPER$(in$(x))
620 IF LEN(pn$(x))>8 THEN 610
625 GOSUB 1765:CLS£2:PRINT£2,pn$(x):INPUT £2,"Without letting the other players
see   type a 2 lettercode for identification, please,",code$(x)
630 CLS£2
635 NEXT
640 RETURN
645 REM:main game loop
650 f=0:pn=FNr(np%)
655 WHILE f=0
660 pn=pn+1:IF pn>np% THEN pn=1
665 IF pr(pn)=1 THEN 825
670 GOSUB 1765:CLS£2:PRINT£2,pn$(pn):INPUT£2, "Please type in your code letters"
;cl$:IF cl$<>code$(pn) THEN 670
675 PRINT£2,"Looking for the floor plan"
680 IF pf%(pn)=0 THEN GOSUB 1780 ELSE GOSUB 1885
685 yy=pl%(pn)
690 CLS£6:FOR x=1 TO 3:LOCATE£6,1,x:PRINT£6,place$(pn,x):NEXT
695 FOR x=1 TO 7:LOCATE£6,1,x+4:PRINT£6,place$(pn,x+3):NEXT
700 FOR x=1 TO 8:LOCATE£6,1,x+12:PRINT£6,place$(pn,x+10):NEXT
705 pv$(pn)=pv$(pn)+LEFT$(r$(yy),1)
710 CLS£7:PRINT£7,pv$(pn)
715 IF bf%(pn)=1 THEN LOCATE£7,6,3:PRINT£7,"BODY IS IN ";LEFT$(r$(b%),1)
720 CLS£2:PRINT£2,"You are standing in the ";r$(yy) :GOSUB 1750:GOSUB 970
725 GOSUB 1750
730 CLS£2:fq=0:qa=0:qx=0
735 PRINT£2,"1)QUESTION SUSPECT  2)SEARCH  3)ACCUSE"
740 PRINT£2,"4)NOTHING  5)PICK UP  6)FILCH"
745 GOSUB 1765:INPUT£2,"Which option do you want(1-6)";op%
750 IF op%<1 OR op%>6 THEN PRINT£2,"Try again":GOTO 730
755 ON op% GOSUB 1200,1320,1470,1705,1340,1410
760 IF fq=1 THEN 730
765 IF pr(pn)=1 THEN 825
770 IF f=1 THEN 825
775 CLS£2:PRINT£2,"Looking for the floor plan":IF pf%(pn)=0 THEN GOSUB 1780 ELSE
 GOSUB 1885
780 CLS£2: fd=0:PRINT£2,"You are standing in the ";r$(yy)
785 PRINT£2, "You can move ";:
790 FOR x=1 TO 4
795 IF dr$(yy,x)<>"Q" THEN PRINT £2,dr$(yy,x);" ";
800 NEXT
805 GOSUB 1765:LOCATE£2,1,3: INPUT£2,"Move to another room (y/n)";ans$
810 IF ans$<>"y" AND ans$<>"n" THEN 805
815 IF ans$="y" THEN GOSUB 895:IF fd=1 THEN 780 ELSE yy=pl%(pn):CLS£2:PRINT£2,"Y
ou are moving to the ";r$(yy):GOSUB 1750
820 CLS£1:CLS£2:CLS£6:CLS£7:qx=0:qa=0: GOSUB 2295
825 WEND
830 CLS:LOCATE 12,3:PRINT pn$(pn);" YOU HAVE WON !"
835 GOSUB 2305
840 PRINT :PRINT
845 PRINT "TO HELP THE OTHER CRIME BUSTERS THIS IS"
850 PRINT"THE SOLUTION"
855 PRINT:PRINT"The murderer was the ";s$(m%)
860 PRINT"The accomplice was the "s$(a%)
865 PRINT"The murder weapon was the ";w$(mw%)
870 PRINT"The stolen article was the ";v$(sa%)
875 PRINT"The body was in the ";r$(b%)
```

TVM

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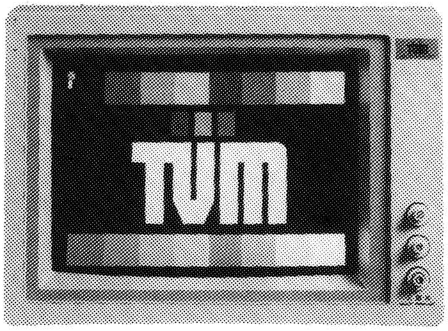

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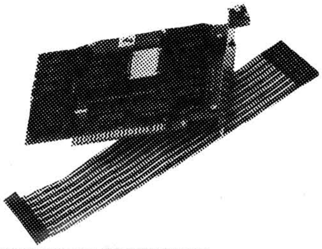

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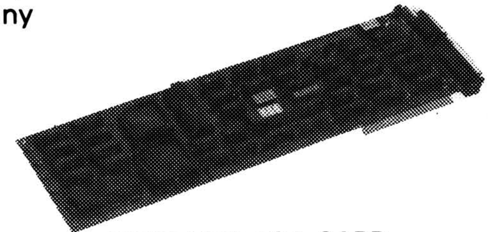

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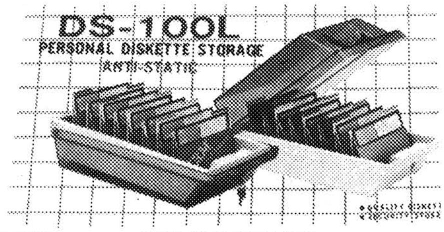

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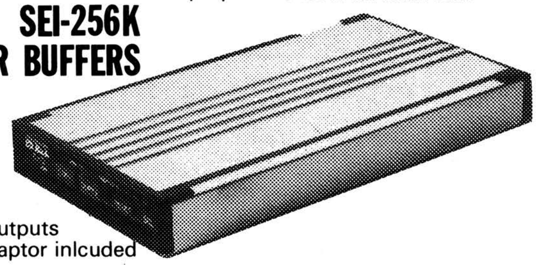

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— Dual outputs
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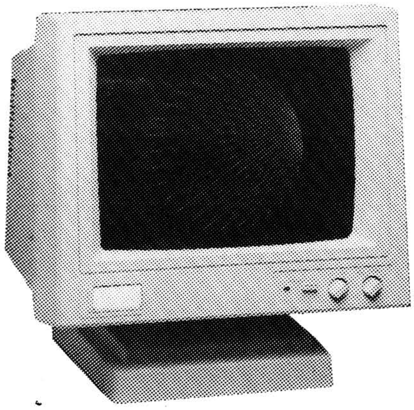

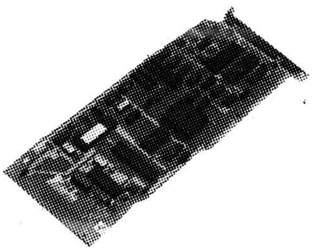

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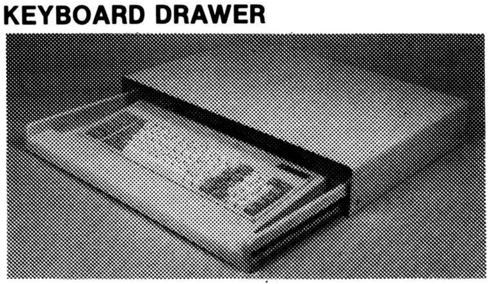

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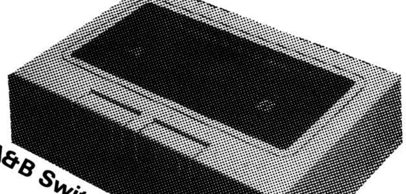
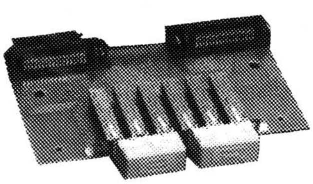


Push Button



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```
880 PRINT"The "w$(mw%);" was in the ";r$(mw%)
885 PRINT:PRINT"Hope you enjoyed playing CRIME BUSTERS !"
890 GOTO 890
895 CLS£2
900 GOSUB 1765:INPUT£2,"Type initial letter of the direction youwish to move";di
r$
905 IF dir$="n"AND dr$(pl%(pn),1)="N" THEN xx=1:GOTO  950
910 IF dir$="s"AND dr$(pl%(pn),2)="S" THEN xx=2:GOTO 950
915 IF dir$="e"AND dr$(pl%(pn),3)="E" THEN xx=3:GOTO 950
920 IF dir$="w"AND dr$(pl%(pn),4)="W" THEN xx=4:GOTO  950
925 IF dir$="u"AND dr$(pl%(pn),1)="UP" THEN xx=1:pf%(pn)=1:GOTO 950
930 IF dir$="d"AND dr$(pl%(pn),1)="DOWN" THEN xx=1:pf%(pn)=0:GOTO 950
935 CLS£2:PRINT£2,"You can't move that way":FOR x=1 TO 1500:NEXT
940 PRINT £2,"You are standing in the ";r$(yy)
945 GOTO 900
950 IF nr%(yy,xx)>100 THEN GOSUB 1105:GOTO 960
955 b=nr%(yy,xx)
960 pl%(pn)=b
965 RETURN
970 CLS£1:CLS£2
975 fl=0
980 IF pc%(pn)=0 THEN PRINT£2,"You are carrying nothing":GOTO 995
985 IF pc%(pn)=13 THEN PRINT£2,"You are carrying the skeleton key":GOTO 995
990 PRINT£2,"You are carrying the ";r$(pc%(pn));" key"
995 PRINT£1,"You can see"
1000 fl=0
1005 FOR x=1 TO 7:IF v%(x)=0 THEN 1015
1010 IF v%(x)=r%(yy) THEN PRINT£1,CHR$(32);v$(x):fl=1:place$(pn,x+3)=LEFT$(r$(yy
),1)
1015 NEXT
1020 PRINT£1
1025 FOR x=1 TO 12
1030 IF k%(x)=r%(yy) THEN PRINT£1,x;r$(x);" key":fl=1
1035 NEXT
1040 IF k%(13)=r%(yy)THEN PRINT£1,"13 SKELETON key":fl=1
1045 PRINT£1
1050 fb=0: FOR x=1 TO 8
1055 IF s%(x)=r%(yy) THEN PRINT£1,CHR$(32);s$(x):fl=1:place$(pn,x+10)=LEFT$(r$(y
y),1)
1060 NEXT
1065 FOR x=1 TO np%
1070 IF x=pn THEN 1080
1075 IF pl%(x)=r%(yy) THEN PRINT£1,x;pn$(x):fl=1
1080 NEXT
1085 PRINT £1
1090 IF b%=r%(yy)THEN PRINT£1,CHR$(32);"The cook's body.":PRINT£1," She has been
 ";md$:fl=1:bf%(pn)=1
1095 IF fl=0 THEN PRINT£1,"NOTHING OF INTEREST"
1100 RETURN
1105 b=nr%(yy,xx)-100:a=yy
1110 IF a*b=3 THEN d=1
1115 IF a*b=12 THEN d=2
1120 IF a*b=28 THEN d=3
1125 IF a*b=42 THEN d=4
1130 IF a*b=10 THEN d=5
1135 IF a*b=110 THEN d=6
1140 IF a*b=96 THEN d=7
1145 IF a*b=72 THEN d=8
1150 IF d%(d)=0 THEN 1190
1155 IF d%(d)=1 THEN CLS£2:IF pc%(pn)<>a AND pc%(pn)<>b AND pc%(pn)<>13 THEN PRI
NT£2,"The door is locked and you haven't a key":fd=1:GOSUB 1750:RETURN
1160 IF pc%(pn)=13 THEN PRINT £2,"The door is locked but the skeleton key will o
pen it":d%(d)=0:GOSUB 1750:GOTO 1195
1165 PRINT£2,"the door is locked but you have the ";r$(pc%(pn));" key"
1170 GOSUB 1765:INPUT£2,"Do you want to lock the door behind you (y/n)";ld$
1175 IF ld$<>"y" AND ld$<>"n" THEN 1170
1180 IF ld$="y" THEN d%(d)=1:GOTO 1195
1185 d%(d)=0:GOTO 1195
1190 IF pc%(pn)=a OR pc%(pn)=b THEN PRINT£2,"You have the ";r$(pc%(pn));" key":G
OTO 1170
1195 RETURN
1200 FOR x=1 TO 8:IF s%(x)=pl%(pn) THEN vv=1
1205 NEXT
1210 IF vv=0 THEN PRINT£2,"There are no suspects in this room":fq=1:GOSUB 1750:R
ETURN
1215 WHILE qa<nqr:GOSUB 1765:CLS£2: INPUT£2,"Which suspect do you wish to questi
on   (1-8).Type 9 if no further questions";qs:IF qs<1 OR qs>9 THEN 1215
1220 IF qs=9 THEN qa=nqr:GOTO 1315
1225 IF s%(qs)<>pl%(pn) THEN PRINT£2,"The ";s$(qs);" is not in this room":GOSUB
1750:GOTO 1215
1230 CLS£2:PRINT£2,"a) WHERE IS THE....(1-8)"
1235 PRINT£2,"b) AT THE TIME OF THE MURDER WHERE WAS"
1240 PRINT£2,"THE....(1-8)
1245 GOSUB 1765:PRINT£2,"Which question do you want to put to the ";s$(qs);" (a
or b)";:INPUT£2,wq$
1250 IF wq$<>"a"AND wq$<>"b" THEN 1230
1255 GOSUB 1765:IF wq$="a" THEN CLS£2: INPUT£2,"Whose whereabouts do you wish to
 know (1-8)";wh: PRINT£2,"The ";s$(wh);" is in the ";r$(s%(wh)):GOTO 1305
1260 CLS£2:GOSUB 1765:INPUT£2,"Whose whereabouts at the time of the murder do yo
u wish to know (1-8)";wt
1265 IF wt=qs THEN PRINT£2,"I'm not telling you !" :GOTO 1305
1270 CLS£2:IF sk(qs)<>wt AND sk%(qs)<>wt THEN PRINT£2,"The "; s$(qs)" doesn't kn
ow"
1275 IF sk(qs)=wt AND qs=m% THEN PRINT£2,"The ";s$(wt);" was in the ";r$(sw(sk%(
qs))):GOTO 1305
1280 IF sk%(qs)=wt AND qs=m% THEN PRINT£2,"The ";s$(wt);" was in the ";r$(b%):GO
TO 1305
1285 IF sk(qs)=wt AND qs=a% THEN PRINT£2,"The ";s$(wt);" was in the ";r$(sw(sk%(
qs))):GOTO 1305
1290 IF sk%(qs)=wt AND qs=a% THEN PRINT£2,"The ";s$(wt);" was in the ";r$(b%):GO
TO 1305
1295 IF sk(qs)=wt THEN PRINT£2,"The ";s$(wt);" was in the "; r$(sw(wt))
1300 IF sk%(qs)=wt THEN PRINT£2,"The ";s$(wt);" was in the ";r$(sw(wt))
1305 qa=qa+1 :GOSUB 1750
1310 WEND
1315 RETURN
1320 CLS£2:kk=0: FOR x=1 TO 3:IF w%(x)=pl%(pn) THEN PRINT£2,"You find the ";w$(x
):kk=1:PRINT£2,"On it are a ";p$(x);" fingerprints":place$(pn,x)=LEFT$(r$(yy),1)
 +CHR$(32)+LEFT$(p$(x),1)
1325 NEXT
1330 IF kk=0 THEN PRINT£2,"You find nothing"
1335 GOSUB 1750:RETURN
1340 CLS£2:fk=0:FOR x=1 TO 13:IF k%(x)=r%(yy) THEN fk=1
1345 NEXT
1350 IF fk=0 THEN PRINT£2,"There are no keys to pick up":GOSUB 1750:RETURN
1355 GOSUB 1765:INPUT£2,"Which key do you want to pick up(1-13)";kp
1360 IF k%(kp)<>r%(yy) THEN PRINT£2,"The ";r$(kp);" key is not in this room":GOS
UB 1750:RETURN
1365 IF kp=13 THEN PRINT£2,"You have picked up the SKELETON key":GOTO 1375
1370 PRINT£2,"You have picked up the ";r$(kp);" key"
1375 dk=pc%(pn):IF dk=0 THEN 1395
1380 IF dk<13 THEN PRINT£2,"You have dropped the ";r$(dk);" key":GOTO 1390
1385 IF dk=13 THEN PRINT£2,"You have dropped the SKELETON key"
1390 k%(dk)=yy
1395 pc%(pn)=kp
1400 k%(kp)=0
1405 GOSUB 1750:RETURN
1410 fp=0:CLS£2:FOR x=1 TO np%:IF pl%(x)=yy AND x<>pn THEN fp=1
1415 NEXT
1420 IF fp=0 THEN PRINT£2,"There are no players here":GOSUB 1750:RETURN
1425 GOSUB 1765:INPUT£2,"From which player do you want to filch ?Type number sho
wn before their name";pf
1430 IF pl%(pf)<>r%(yy) THEN PRINT£2,pn$(pf);" is not here":GOSUB 1750:RETURN
1435 IF pc%(pf)=0 THEN PRINT£2,pn$(pf);" is not carrying anything":GOSUB 1750:RE
TURN
1440 IF pc%(pf)<13 THEN PRINT£2,"You have filched the ";r$(pc%(pf));" key":GOTO
1450
1445 IF pc%(pf)=13 THEN PRINT£2,"You have filched the SKELETON key":GOTO 1450
1450 IF pc%(pn)=0 THEN 1465
1455 IF pc%(pn)<13 THEN PRINT£2,"You have dropped the ";r$(pc%(pn));" key":k%(pc
%(pn))=yy
1460 IF pc%(pn)=13 THEN PRINT£2"You have dropped the SKELETON KEY":k%(13)=yy
1465 pc%(pn)=pc%(pf):pc%(pf)=0:GOSUB 1750:RETURN
1470 CLS£2:PRINT£2,"YOU MUST GIVE THE FOLLOWING INFORMATION"
1475 PRINT£2,"CORRECTLY:  MURDERER,ACCOMPLICE,WEAPON,"
1480 PRINT£2,"STOLEN OBJECT,LOCATIONS OF BODY & WEAPON";
1485 GOSUB 1765:INPUT£2,"Are you prepared (y/n)";yp$
1490 IF yp$<>"y" AND yp$<>"n" THEN 1485
1495 IF yp$="n" THEN fq=1:RETURN
1500 wa=0
1505 GOSUB 1765:CLS£2:INPUT£2,"Type in the number of the MURDERER (1-8)";mg
1510 IF mg<1 OR mg>8 THEN 1505
1515 GOSUB 1765: PRINT£2,"You say the murderer is the ";s$(mg):INPUT£2,"(y/n)";a
ns$
1520 IF ans$<>"y"AND ans$<>"n" THEN 1515
1525 IF ans$="n" THEN 1505
1530 IF s%(mg)<>pl%(pn) THEN PRINT £2,"You must be in the same room as the suspe
ct you accuse":fq=1:GOSUB 1750:RETURN
1535 IF mg<>m% THEN wa=1
1540 GOSUB 1765: CLS£2:INPUT£2,"Type in the number of the ACCOMPLICE (1-8)";ag
1545 IF ag<1 OR ag>8 THEN 1540
1550 GOSUB 1765: PRINT£2,"You say the accomplice is the ";s$(ag):INPUT£2,"(y/n)"
;ans$
1555 IF ans$<>"y"AND ans$<>"n" THEN 1550
1560 IF ans$="n" THEN 1540
1565 IF ag<>a% THEN wa=1
```

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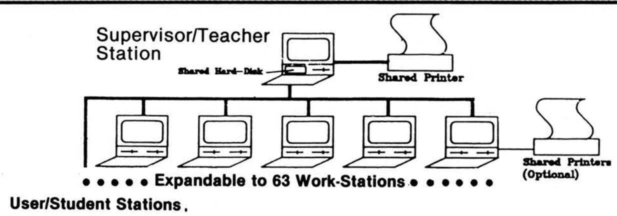

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```
1570 GOSUB 1765:CLS£2:INPUT£2,"Type in the number of the WEAPON (1-3)";wg
1575 IF wg<1 OR wg>3 THEN 1570
1580 GOSUB 1765: PRINT£2,"You say the weapon is the ";w$(wg):INPUT£2,"(y/n)";ans
$
1585 IF ans$<>"y"AND ans$<>"n" THEN 1580
1590 IF ans$="n" THEN 1570
1595 IF wg<>mw% THEN wa=1
1600 GOSUB 1765:CLS£2:INPUT£2,"Type in the number of the STOLEN OBJECT (1-7)";og
1605 IF og<1 OR og>7 THEN 1600
1610 GOSUB 1765:PRINT£2,"You say the object is the ";v$(og):INPUT£2,"(y/n)";ans$
1615 IF ans$<>"y"AND ans$<>"n" THEN 1610
1620 IF ans$="n" THEN 1600
1625 IF og<>sa% THEN wa=1
1630 CLS£1:FOR x= 1 TO 14:PRINT£1,x;") ";r$(x):NEXT
1635 GOSUB 1765:CLS£2:INPUT£2,"In which room was the body (1-14)";gb
1640 IF gb<1 OR gb>14 THEN 1635
1645 GOSUB 1765:PRINT£2,"You say the body was in the ";r$(gb):INPUT£2,"(y/n)";an
s$
1650 IF ans$<>"y"AND ans$<>"n" THEN 1645
1655 IF ans$="n" THEN 1635
1660 IF gb<>b% THEN wa=1
1665 GOSUB 1765:CLS£2:INPUT£2,"In which room was the weapon (1-14)";gw
1670 IF gw<1 OR gw>14 THEN 1665
1675 GOSUB 1765:PRINT£2,"You say the weapon was in the ";r$(gw):INPUT£2,"(y/n)";
ans$
1680 IF ans$<>"y"AND ans$<>"n" THEN 1675
1685 IF ans$="n" THEN 1665
1690 IF gw<>w%(mw%) THEN wa=1
1695 IF wa=0 THEN f=1:RETURN
1700 IF wa=1 THEN GOSUB 1710
1705 RETURN
1710 CLS£1:PRINT£1, pn$(pn);" YOU HAVE FAILED"
1715 PRINT£1:PRINT£1,"YOU ARE NO LONGER A"
1720 PRINT £1,"CRIME BUSTER !"
1725 PRINT£1:PRINT£1,"IN FACT YOU'RE OUT OF  THE GAME !"
1730 GOSUB 2300
1735 pr(pn)=1:pl%(pn)=0
1740 GOSUB 1750
1745 RETURN
1750 PRINT£2,"PRESS SPACE BAR TO CONTINUE"
1755 IF INKEY(47)<>0 THEN 1755
1760 RETURN
1765 cb$=INKEY$:IF cb$<>"" THEN 1765
1770 RETURN
1775 REM:ground floor plan
1780 CLS£1:LOCATE£1,1,1:INK 3,20
1785 PRINT£1,CHR$(150);STRING$(8,154);CHR$(158);STRING$(12,154);CHR$(156);
1790 PRINT£1,CHR$(149);"UTILITY ";CHR$(149);"CONSERVATORY";CHR$(149);
1795 PRINT£1,CHR$(149);"  ROOM  ";CHR$(240);SPACE$(12);CHR$(149);
1800 PRINT£1,CHR$(149);SPACE$(8);CHR$(151);CHR$(154);CHR$(158);CHR$(154);CHR$(15
4);CHR$(158);STRING$(3,154);CHR$(241);STRING$(3,154);CHR$(157);
1805 PRINT£1,CHR$(151);STRING$(7,154);CHR$(32);CHR$(159);CHR$(154);CHR$(157);SPA
CE$(2);CHR$(149);SPACE$(7);CHR$(149);
1810 PRINT£1,CHR$(149);SPACE$(8);CHR$(151);CHR$(154);CHR$(157);SPACE$(2);CHR$(14
9);SPACE$(7);CHR$(149);
1815 PRINT£1,CHR$(149);SPACE$(8);CHR$(151);CHR$(154);CHR$(157);SPACE$(2);CHR$(14
9);"SITTING";CHR$(149);
1820 PRINT£1,CHR$(149);SPACE$(8);CHR$(151);CHR$(154);CHR$(157);SPACE$(2);CHR$(14
9);" ROOM  ";CHR$(149);
1825 PRINT£1,CHR$(149);"KITCHEN ";CHR$(151);CHR$(154);CHR$(153);SPACE$(2);CHR$(1
49);SPACE$(7);CHR$(149);
1830 PRINT£1,CHR$(149);SPACE$(21);CHR$(149);
1835 PRINT£1,CHR$(151);STRING$(3,154);CHR$(241);STRING$(3,154);;CHR$(158);CHR$(1
53);SPACE$(4);CHR$(149);SPACE$(7);CHR$(149);
1840 PRINT£1,CHR$(149);SPACE$(7);CHR$(149);" HALL";CHR$(151);STRING$(3,154);CHR$
(241);STRING$(3,154);CHR$(157);
1845 PRINT£1,CHR$(149);"REFECT-";CHR$(149);SPACE$(5);CHR$(149);SPACE$(7);CHR$(14
9);
1850 PRINT£1,CHR$(149);"ORY    ";CHR$(151);STRING$(2,154);CHR$(32);STRING$(2,154
);CHR$(157);"MORNING";CHR$(149);
1855 PRINT£1,CHR$(149);SPACE$(7);CHR$(149);"FOYER";CHR$(149);" ROOM  ";CHR$(149)
;
1860 PRINT£1,CHR$(149);SPACE$(13);CHR$(240);SPACE$(7);CHR$(149);
1865 PRINT£1,CHR$(147);STRING$(7,154);CHR$(155);STRING$(5,154);CHR$(155);STRING$
(7,154);CHR$(153);
1870 INK 3,6
1875 RETURN
1880 REM :1st floor plan
1885 CLS£1:LOCATE£1,1,1:INK 3,20
1890 PRINT£1,CHR$(150);STRING$(8,154);CHR$(158);STRING$(4,154);CHR$(158);STRING$
(7,154);CHR$(156);
1895 PRINT£1,CHR$(149);SPACE$(9);"  P ";SPACE$(8);CHR$(149);
1900 PRINT£1,CHR$(149);SPACE$(8);CHR$(149);"  A ";CHR$(149);" GUEST ";CHR$(149);
1905 PRINT£1,CHR$(149);" BEDROOM";CHR$(151);CHR$(154);CHR$(156);"S ";CHR$(149);S
PACE$(7);CHR$(149);
1910 PRINT£1,CHR$(149);SPACE$(8);CHR$(151);CHR$(154);CHR$(157);"S ";CHR$(149);"
ROOM  ";CHR$(149);
1915 PRINT£1,CHR$(149);SPACE$(8);CHR$(151);CHR$(154);CHR$(157);"A ";CHR$(149);SP
ACE$(7);CHR$(149);
1920 PRINT£1,CHR$(149);SPACE$(8);CHR$(151);CHR$(154);CHR$(157);"G ";CHR$(149);SP
ACE$(7);CHR$(149);
1925 PRINT£1,CHR$(149);SPACE$(8);CHR$(151);CHR$(154);CHR$(153);"E ";CHR$(151);ST
RING$(3,154);CHR$(241);STRING$(3,154);CHR$(157);
1930 PRINT£1,CHR$(149);SPACE$(8);CHR$(149);SPACE$(4);CHR$(149);"LINEN  ";CHR$(14
9);
1935 PRINT£1,CHR$(149);SPACE$(8);CHR$(149);CHR$(32);CHR$(150);CHR$(154);CHR$(32)
;CHR$(157);"ROOM";SPACE$(3);CHR$(149);
1940 PRINT£1,CHR$(151);STRING$(3,154);CHR$(241);STRING$(4,154);CHR$(155);CHR$(15
4);CHR$(157);SPACE$(10);CHR$(149);
1945 PRINT£1,CHR$(149);SPACE$(10);CHR$(149);SPACE$(2);CHR$(147);STRING$(7,154);C
HR$(157);
1950 PRINT£1,CHR$(149);" DRESSING ";CHR$(149);SPACE$(10);CHR$(149);
1955 PRINT£1,CHR$(149);SPACE$(3);"ROOM";SPACE$(3);CHR$(240);" NURSERY  ";CHR$(14
9);
1960 PRINT£1,CHR$(149);SPACE$(10);CHR$(149);SPACE$(10);CHR$(149);
1965 PRINT£1,CHR$(149);SPACE$(10);CHR$(149);SPACE$(10);CHR$(149);
1970 PRINT£1,CHR$(147);STRING$(10,154);CHR$(155);STRING$(10,154);CHR$(153);
1975 INK 3,6
1980 RETURN
1985 REM:title screen
1990 BORDER 0:PAPER 0:INK 0,0:PEN 1:INK 1,26:PEN 2:INK 2,6:PEN 3:INK 3,0,26:CLS
1995 ld$=CHR$(2)+CHR$(10)+CHR$(8)+CHR$(8)
2000 up$=STRING$(3,11)
2005 hd$=CHR$(10)+CHR$(8)
2010 lc$=CHR$(204)+CHR$(205)+ld$+CHR$(211)+hd$+CHR$(211)+hd$+CHR$(205)+CHR$(204)
+up$
2015 lr$=CHR$(242)+CHR$(205)+CHR$(10)+STRING$(2,8)+CHR$(243)+CHR$(204)+CHR$(10)+
STRING$(2,8)+CHR$(211)+CHR$(205)+CHR$(10)+STRING$(2,8)+CHR$(211)+CHR$(209)+up$
2020 hi$=CHR$(211)+hd$:li$=hi$+hi$+hi$+CHR$(211)+up$
2025 hm$=CHR$(211)+CHR$(209)+ld$:lm$=CHR$(244)+CHR$(245)+ld$+hm$+hm$+CHR$(211)+C
HR$(209)+up$
2030 le$=CHR$(242)+CHR$(208)+ld$+CHR$(243)+CHR$(210)+ld$+CHR$(211)+hd$+CHR$(243)
+CHR$(210)+up$
2035 lb$=CHR$(242)+CHR$(205)+ld$+CHR$(243)+CHR$(204)+ld$+CHR$(211)+CHR$(205)+ld$
+CHR$(243)+CHR$(204)+up$
2040 lu$=hm$+hm$+hm$+CHR$(205)+CHR$(204)+up$
2045 ls$=CHR$(204)+CHR$(205)+ld$+CHR$(205)+CHR$(10)+CHR$(205)+ld$+CHR$(205)+CHR$
(204)+up$
2050 lt$=CHR$(208)+CHR$(242)+hd$+CHR$(211)+hd$+CHR$(211)+hd$+CHR$(211)+up$
2055 gun$=CHR$(210)+CHR$(246)+STRING$(4,210)+CHR$(247)+CHR$(248)+CHR$(249)+CHR$(
10)+STRING$(9,8)
2060 gun$=gun$+CHR$(243)+STRING$(2,210)+CHR$(249)+SPACE$(4)+CHR$(149)+CHR$(10)+S
TRING$(6,8)
2065 gun$=gun$+CHR$(147)+CHR$(250)+CHR$(154)+CHR$(254)+CHR$(32)+CHR$(253)+CHR$(2
55)+CHR$(10)+STRING$(6,8)+CHR$(193)+CHR$(154)+CHR$(211)+SPACE$(2)+CHR$(205)+CHR$
(10)+STRING$(4,8)
2070 gun$=gun$+CHR$(205)+CHR$(255)+CHR$(32)+CHR$(209)+CHR$(10)+STRING$(3,8)+CHR$
(251)+CHR$(210)+CHR$(252)
2075 bul$=CHR$(231)+CHR$(32)
2080 WINDOW£1,31,40,6,12:PAPER £1,0:CLS£1:PEN£1,2:PRINT£1,gun$
2085 WINDOW£2,1,18,6,9:PEN£2,1
2090 LOCATE 30,7:PRINT CHR$(238):GOSUB 2250:FOR x=1 TO 250:NEXT:FOR x=29 TO 9 ST
EP-1:LOCATE x,7:PRINT bul$;:FOR y=1 TO 5:NEXT:NEXT
2095 PAPER £2,3:CLS£2:FOR x=1 TO 700:NEXT :PAPER£2,0 :CLS£2
2100 PRINT£2, USING"&";lc$;" ";lr$;" ";li$;" ";lm$;" ";le$:FOR z=1 TO 1500:NEXT
2105 CLS£1:WINDOW£1,31,40,14,20:PRINT£1,gun$
2110 LOCATE 30,15:PRINT CHR$(238):GOSUB 2250:FOR x=1 TO 250:NEXT:FOR x=29 TO 12
STEP-1:LOCATE x,15:PRINT bul$;:FOR y=1 TO 5:NEXT:NEXT
2115 WINDOW£3,1,24,13,16 :PEN£3,1:PAPER £3,3:CLS£3:FOR x=1 TO 700:NEXT :PAPER£3,
0 :CLS£3
2120 PRINT£3, USING"&";lb$;" ";lu$;" ";ls$;" ";lt$;" ";le$;" ";lr$;" ";ls$:FOR z
=1 TO 1500:NEXT
2125 l1$="TO ALL CRIME BUSTERS STOP"
2130 l2$="PROCEDE AT ONCE TO STRANGEWAYS HALL STOP"
2135 l3$="INVESTIGATE REPORT OF ARMED ROBBERY STOP"
2140 l4$="BELIEVED COOK HAS BEEN MURDERED STOP IT"
2145 l5$="SEEMS MOST LIKELY THAT IT IS AN INSIDE"
2150 l6$="JOB STOP NOBODY HAS LEFT THE HOUSE SO"
2155 l7$="THIS ASSIGNMENT SHOULD NOT PROVE TOO"
2160 l8$="DIFFICULT STOP AN ARREST SHOULD BE MADE "
2165 l9$="WITHIN THE HOUR STOP GOOD LUCK STOP"
2170 l10$="MESSAGE ENDS"
2175 GOSUB 2260
2180 ENT -2,1,1,8,1,-1,8:ENV 2,5,3,2,9,-1,20,5,-1,2
```

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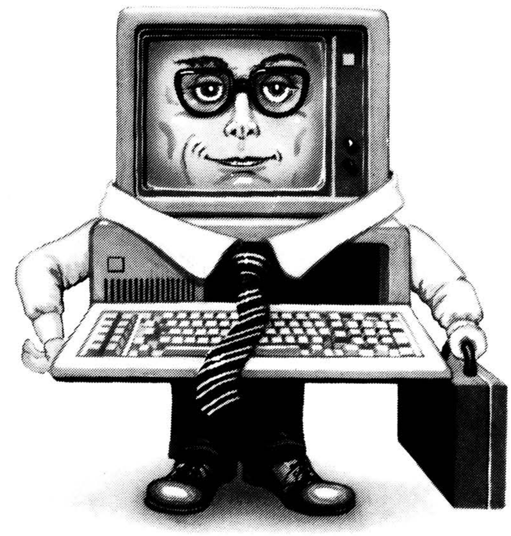
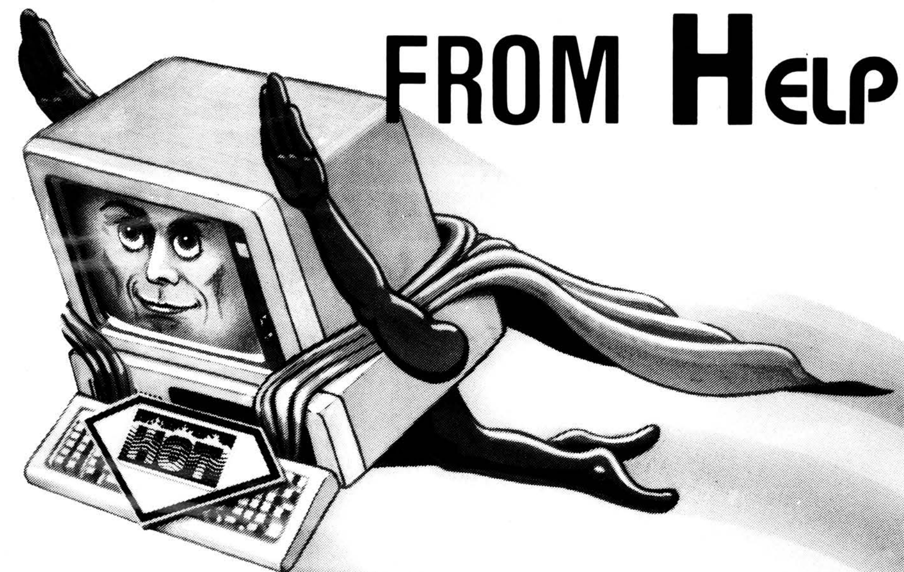


FROM HELP ON TAP



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```
2185 ON SQ(1)GOSUB 2285
2190 PAPER 0:PEN 1:CLS:FOR x=1 TO 39:PRINT MID$(11$,x,1);:FOR y=1 TO 30: NEXT:NE
XT:PRINT :PRINT
2195 FOR x=1 TO 40:PRINT MID$(12$,x,1);:FOR y=1 TO 30: NEXT:NEXT :PRINT
2200 FOR x=1 TO 40:PRINT MID$(13$,x,1);:FOR y=1 TO 30: NEXT:NEXT:PRINT
2205 FOR x=1 TO 39:PRINT MID$(14$,x,1);:FOR y=1 TO 30: NEXT:NEXT:PRINT:PRINT
2210 FOR x=1 TO 38:PRINT MID$(15$,x,1);:FOR y=1 TO 30: NEXT:NEXT:PRINT:PRINT
2215 FOR x=1 TO 37:PRINT MID$(16$,x,1);:FOR y=1 TO 30: NEXT:NEXT:PRINT:PRINT
2220 FOR x=1 TO 36:PRINT MID$(17$,x,1);:FOR y=1 TO 30: NEXT:NEXT:PRINT:PRINT
2225 FOR x=1 TO 39:PRINT MID$(18$,x,1);:FOR y=1 TO 30: NEXT:NEXT:PRINT:PRINT
2230 FOR x=1 TO 35:PRINT MID$(19$,x,1);:FOR y=1 TO 30: NEXT:NEXT:PRINT:PRINT
2235 FOR x=1 TO 12:PRINT MID$(110$,x,1);:FOR y=1 TO 30: NEXT:NEXT
2240 FOR x=1 TO 5000:NEXT
2245 RETURN
2250 ENV 3,15,-1,10:SOUND 1,0,80,15,3,0,15
2255 RETURN
2260 tempo=25: FOR s=1 TO 34:READ voicel(s),lenl(s):lenl(s)=lenl(s)*tempo:NEXT
2265 FOR x=1 TO 21:READ voi(x),leni(x):leni(x)=leni(x)*10:NEXT
2270 FOR x=1 TO 15:READ vot(x),lent(x):lent(x)=lent(x)*tempo:NEXT
2275 FOR x=1 TO 17:READ voiw(x),lenw(x):lenw(x)=lenw(x)*tempo:NEXT
2280 p=1:RETURN
2285 IF p<35 THEN SOUND 1,voicel(p),lenl(p),0,2,2:p=p+1:ON SQ(1) GOSUB 2285
2290 RETURN
2295 FOR x=1 TO 21:SOUND 2,voi(x),leni(x),6:NEXT:RETURN
2300 FOR x=1 TO 15:SOUND 1,vot(x),lent(x),6:NEXT:RETURN
2305 FOR x=1 TO 17: SOUND 1,voiw(x),lenw(x),0,2,2:NEXT:RETURN
2310 SYMBOL 240,0,0,0,7,253,103,96,0
2315 SYMBOL 241,56,40,56,16,16,28,28,16
2320 SYMBOL 242,255,255,192,192,192,192,192,192
2325 SYMBOL 243,192,192,192,192,192,192,255,255
2330 SYMBOL 244,192,224,240,216,204,198,195,193
2335 SYMBOL 245,3,7,15,27,51,99,195,131
2340 SYMBOL 246,0,0,0,255,255,195,195,195
2345 SYMBOL 247,0,0,0,255,255,192,192,192
2350 SYMBOL 248,0,0,0,255,255,3,3,3
2355 SYMBOL 249,0,0,010,0,0,248,248
2360 SYMBOL 250,0,0,0,255,255,24,24,24
2365 SYMBOL 251,192,192,192,224,112,56,31,15
2370 SYMBOL 252,3,3,3,7,14,28,248,240
2375 SYMBOL 253,24,24,24,24,28,14,7,3
2380 SYMBOL 254,0,0,0,192,192,192,192,192
2385 SYMBOL 255,0,0,0,0,0,0,0,128
2390 RETURN
2395 DATA 239,2,190,2,159,3,159,1,142,2,142,2,159,2,190,2
2400 DATA 239,2,190,2,159,3,159,1,179,2,190,2,213,4
2405 DATA 239,2,190,2,159,3,159,1,239,2,190,2,213,2,239,2,253,1,284,1,319,2
2410 DATA 239,3,190,1,159,2,190,2,179,1,179,1,190,2,239,4
2415 DATA 402,1,379,4,0,3,338,1,319,4,0,3,402,1,379,3,338,1,319,3,239,1,253,3,37
9,1,319,3,253,1,268,8,284,1.33,319,1.33,379,1.33,425,1.33,379,8
2420 DATA 238,1,212,1,190,1,178,1,134,1,142,1,178,1,160,1,190,1.178,2,358,.75,0,
.25,358,.75,0,.25,358,1
2425 DATA 239,2,179,6,159,.67,239,.67,159,.67,142,1.8,0,.2,142,1.8,0,.2,142,1.8,
0,.2,142,.67,134,.67,179,.67,142,3,159,1,179,6
2430 DATA N,Q,E,W,N,Q,E,Q,N,Q,Q,W,N,S,Q,W,N,S,E,Q,Q,S,E,Q,Q,S,Q,W,N,Q,E,Q,Q,S,E,
Q,Q,S,Q,W,N,Q,Q,W,N,Q,E,W,DOWN,S,E,W,UP,S,E,W
2435  DATA 14,0,103,2,105,0,1,0,104,0,0,101,107,103,0,14,6,102,14,0,0,5,107,0,0,
104,0,106,109,0,112,0,0,108,13,0,0,111,0,13,110,0,0,12,13,0,11,108,14,12,10,9,13
,1,4,5
2440 DATA GUN,HAMMER,KNIFE
2445 DATA NECKLACE,MING VASE,CORONET,CASH BOX,STAMPS,COINS,RING
2450 DATA DUKE,BUTLER,CHAUFFER,GARDENER,DUCHESS,GOVERNESS,NANNY,MAID
2455 DATA FOYER,REFECTORY,MORNING ROOM,SITTING ROOM,KITCHEN,UTILITY ROOM,CONSERV
ATORY,DRESSING ROOM,BEDROOM,GUEST ROOM,LINEN ROOM,NURSERY,PASSAGE,HALL
2460 CLS:PEN 1: PRINT"Your task is to identify the murderer,"
2465 PRINT"the accomplice,the missing valuable,the"
2470 PRINT"location of the body,the murder weapon"
2475 PRINT"and its location."
2480 PRINT"  There are 8 suspects- 4 men and 4"
2485 PRINT"women.At the time of the murder,they"
2490 PRINT"were in 4 seperate rooms(1 man and 1"
2495 PRINT"woman in each room)."
2500 PRINT"  The murderer and the accomplice(of"
2505 PRINT"opposite sex) were in the murder room"
2510 PRINT"where the body lies at present."
2515 PRINT"  Six valuables can be seen as you pass"
2520 PRINT"from room to room.The seventh is the"
2525 PRINT"stolen article which has been removed"
2530 PRINT"from the house."
2535 PRINT"  Finding the body will reveal which"
2540 PRINT"of three possible weapons was used."
2545 PRINT"Knowing the murder room will be of"
2550 PRINT"great help when questioning suspects."
2555 PEN 2:PRINT:PRINT"PRESS SPACE BAR TO CONTINUE"
2560 a$=INKEY$:IF a$<>" "THEN 2560
2565 CLS: PEN 1:PRINT"There are 3 weapons with fingerprints"
2570 PRINT"(male or female) hidden in the rooms 1"
2575 PRINT"of which is the murder weapon. This will";
2580 PRINT"enable you to distinguish between the"
2585 PRINT"murderer and accomplice"
2590 PRINT"  Strangeways Hall has two floors. You"
2595 PRINT"move around using (n)orth,(s)outh,(e)ast";
2600 PRINT"(w)est,(u)p or(d)own when prompted."
2605 PRINT"At your turn you will be shown a plan"
2610 PRINT"of the floor you are on. This plan"
2615 PRINT"shows the names of the rooms and"
2620 PRINT"location of doorways.Some of the doors"
2625 PRINT"are lockable (shown by a key).At the"
2630 PRINT"start 3 doors will be locked. All doors"
2635 PRINT"leading from a room can be locked or"
2640 PRINT"unlocked with the key for that room.At"
2645 PRINT"the start 6 keys will be in the UTILITY"
2650 PRINT"ROOM(ground floor) and 6 in the LINEN"
2655 PRINT"ROOM(first floor). Keys to ground floor"
2660 PRINT"rooms may be on the first floor and vice";
2665 PRINT"versa.
2670 PRINT
2675 PEN 2:PRINT"PRESS SPACE BAR TO CONTINUE"
2680 a$=INKEY$:IF a$<>" "THEN 2680
2685 CLS:PEN 1
2690 PRINT"There is also a skeleton key in one of"
2695 PRINT"the rooms.This key will unlock any door"
2700 PRINT"but cannot be used to lock doors. You "
2705 PRINT"can only carry one key at a time. Using"
2710 PRINT"keys avoids detours which are time"
2715 PRINT"consuming. Three of the rooms have al"
2720 PRINT"their exits lockable so that you may not";
2725 PRINT"be able to see what's in the room unless";
2730 PRINT"you have a key. Also you may get locked"
2735 PRINT"in one of these three rooms.
2740 PRINT"  At the start of the game you will type";
2745 PRINT"in 2 code letters.On your turn you must"
2750 PRINT"type in this code.No other player should";
2755 PRINT"see the screen during your turn. A list"
2760 PRINT"of possible weapons,valuables and"
2765 PRINT"suspects is shown on the left of the"
2770 PRINT"screen. As you find them the initial"
2775 PRINT"letter of the room in which they were"
2780 PRINT"found is shown alongside.The type of"
2785 PRINT"fingerprint(m/f) on the weapons is also"
2790 PRINT"shown.The initial letter of rooms you"
2795 PRINT"have visited is shown at the bottom"
2800 PRINT
2805 PEN 2:PRINT"PRESS SPACE TO CONTINUE"
2810 a$=INKEY$:IF a$<>" " THEN 2810
2815 PEN 1
2820 CLS: PRINT"At your turn you will be shown the room"
2825 PRINT"you are in and a list of its visible"
2830 PRINT"contents. A menu displays the following"
2835 PRINT"options.Only one can be used each turn"
2840 PRINT"NOTHING  Carry on.No option used"
2845 PRINT"PICK UP  Pick up a key.You wil drop any"
2850 PRINT"         other key."
2855 PRINT"SEARCH   Will reveal any hidden weapon"
2860 PRINT"ACCUSE   When you have the answers go to"
2865 PRINT"         the room where the murderer is"
2870 PRINT"         for debriefing"
2875 PRINT"FILCH    If you are in the same room as"
2880 PRINT"         another player,you can steal"
2885 PRINT"         any key they are carrying"
2890 PRINT"QUESTION  At the start of the game, an"
2895 PRINT"agreed number of questions(up to 5) is"
2900 PRINT"fixed for any one turn.There are two"
2905 PRINT"possible questions.You must be in the"
2910 PRINT"same room as the suspect you question."
2915 PRINT"The possible questions are"
2920 PRINT"a) in which room is the...(any suspect)"
2925 PRINT"This question will always be answered"
2930 PRINT"positively and truthfully"
2935 PRINT
2940 PEN 2:PRINT"PRESS SPACE BAR TO CONTINUE"
2945 a$=INKEY$:IF a$<>" "THEN 2945
2950 CLS:PEN 1
2955 PRINT"b) At the time of the murder where was"
2960 PRINT"the...(any suspect)
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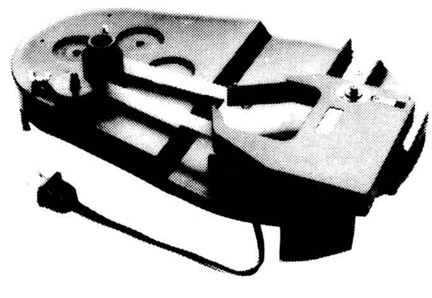

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```
2965 PRINT"The whereabouts of every suspect at the"
2970 PRINT"time of the murder is known by two other";
2975 PRINT"suspects(including the person with them"
2980 PRINT"at the time of the murder).All suspects"
2985 PRINT"with the exception of the murderer and"
2990 PRINT"the accomplice will answer truthfully if";
2995 PRINT"they can.When questioned the muderer"
3000 PRINT"and the accomplice will lie to protect"
3005 PRINT"each other.When questioned,the murderer"
3010 PRINT"will switch the location of the
3015 PRINT"the accomplice with the location of the"
3020 PRINT"other suspect whose whereabouts he knew."
3025 PRINT"The accomplice will use similar tactics"
3030 PRINT"when questioned about the whereabouts of";
3035 PRINT"the murderer."
3040 PRINT"  You will then have the opportunity to"
3045 PRINT"move to another room before your turn"
3050 PRINT"ends.You are advised to have pencil and"
3055 PRINT"paper with you to make notes"
3060 PRINT
3065 PEN 2:INPUT "DO YOU WANT INSTRUCTIONS AGAIN (y/n)";i$
3070 IF i$<>"y" AND i$<>"n"THEN 3070
3075 IF i$="y" THEN 2460
3080 RETURN
```

Commodore 64 IRQ Programs and Memory Saving

by Justin O'Brien

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *66637#.

The first of these tips allows any user with some knowledge of machine code to run simple tasks in a way that doesn't slow down the operation of Basic programs. It makes use of the IRQ service interrupt which occurs every sixtieth of a second to scan the keyboard, and so on. Changing the pointer at locations $314 and $315 enables a short machine code routine to be executed before the normal system servicing at location $EA31.

The program is as follows:

```
10  x=49152
20  READ a
30  IF a=225 THEN 120
40  POKE x,a
50  x=x+1
60  GOTO 20
70  DATA 120,162,15,142,20,3
80  DATA 162,192,142,21,3,88
90  DATA 76,174,167
100 REM DATA ***Your Routine***
110 DATA 76,49,234,255
120 SYS 49152
130 REM    ***Rest of Basic Program***
```

In the 'Your Routine' part of the program, insert the machine code instructions to be executed. An example is:

```
100 DATA 238,0,208 (increases x coord of sprite 0)
110 DATA 206,1,208 (increases y coord of sprite 0)
120 DATA 238,32,208 (flashes the border)
```

To stop the computer executing the added routines, press Run/Stop and RESTORE.

The second tip allows all areas of memory to be saved to cassette, not just the Basic text area as normal. This is done as follows:

POKE 43, (low byte of start address of memory to be saved)
POKE 44, (high byte of start address)
POKE 45, (low byte of end address of memory to be saved +1)
POKE 46, (high byte of end address +1)
SAVE "filename"

This method cannot be used from within a Basic program because it makes the interpreter think that the program is in a different place than it actually is. The routine in the listing allows the same thing from within a Basic program. The first part is the assembly code used, the second a Basic program to put it in memory. When it *is* in memory, it can be used as follows:

POKE 251, low byte of start address
POKE 252, high byte of start address
POKE 253, low byte of end address
POKE 254, high byte of end address

Next, print the required filename in the top-left corner of the screen (memory locations 1024 to 1038) and, finally, type SYS 49152. All this can be done from within a Basic program.

MBasic Structured ON.ERROR

by MJ Buja

One facility which Microsoft Basic lacks is a case-type structuring of the ON ERROR GOTO statement since it can only branch to one line. This tip provides a short bit of code which gets around the problem.

```
10 ON ERROR GOTO 1000
20 ERROR.CODE$=STR$(<ERR.1>)+STR$(<ERR.2>)+STR$(<ERR.3>)
1000 ON (INSTR (ERR.CODE$, STR$(ERR)>-1)/+1 GOTO <TRAP.1>, <TRAP.2>, <TRAP.3>
1010 ON ERROR GOTO 0
```

ERR.1, ERR.2 and ERR.3 are the error codes which are being trapped. They do not have to be strung together with STR$ but can be numbers within quotes (remember — there will be an extra space in this case). Line 1000 searches the string for the code and returns a value which corresponds to the code position, and causes a branch to the appropriate line.

WordStar Tips

by Mandy Alford

In response to the WordStar tip given by M Rhodes in June's 'Program File', here's a simpler way to edit with single-spacing onscreen and print out in double-spacing. Use LH commands at the start of the file. .LH12 to give one-and-a-half spacing and .LH16 to give double-spacing. This facility can be added and removed at any time from the start of the file.

```
C000  A9 01        LDA #$01
C002  A2 01        LDX #$01
C004  A0 FF        LDY #$FF
C006  20 BA FF     JSR $FFBA
C009  A9 0F        LDA #$0F
C00B  A2 00        LDX #$00
C00D  A0 04        LDY #$04
C00F  20 B0 FF     JSR $FFB0
C012  A9 FB        LDA #$FB
C014  A6 FD        LDX $FD
C016  A4 FE        LDY $FE
C018  20 D8 FF     JSR $FFD8
C01B  4C AE A7     JMP $A7AE
```

PROGRAM FILE

APC is interested in programs written in any of the major programming languages for all home and small business micros. When submitting programs please include a cassette or disk version of your program, brief but comprehensive documentation, and a listing on plain white paper —typed if you have no printer.

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Check through the previous Program listings to see the kind of programs we prefer. As a rough guide, original ideas are always welcome, as are good implementations of utilities and applications. Obviously the programs should be well-written, easy to understand, and preferably not too long (remember that other readers have to type them in).

All programs should be fully debugged and your own original, unpublished work. We prefer to receive programs with a maximum 80-column width printed in emphasised typeface.

We will try to return submissions if they are accompanied by a stamped addressed envelope of the appropriate size, but please keep a copy of everything. Programs are paid for at the rate of $20 per page of published listing.

Send to APC Programs, Att. Stephen Crowley, P.O. Box 666, Fitzroy 3065.

by Ben Lin, System Engineer, Marketing Intelligence Centre.

Taiwan's PC industry has made remarkable progress in the past few years. The first 8-bit Apple II compatible machine appeared on the local market late in 1981, and shipments grew quickly in the following two years. 16-bit IBM PC compatibles showed up at the end of 1983 in Taiwan, replacing the 8-bit machines on the market.

Currently there are some 200 PC manufacturers in Taiwan, many of them have less than 10 employees, and you may find a three-man company by chance. The number of manufacturers with 'significant' shipments is estimated at 30, and their combined shipments account for more than 90 per cent of the total shipments of PCs exported or sold to local users.

Around 850,000 PCs were exported by the top 20 PC manufacturers in 1985. The captive production of Atari, Wang and Wyse accounted for 700,000 of that total.

Some 60,000 PCs were sold to local users in 1985, with 16-bit machines occupying the lion's share. The 8-bit machines are predicted to phase out in less than 2 years. By now, virtually no office or serious users will buy 8-bit machines.

Compared with the situation two years ago, local users are very concerned about the Chinese manipulation capability of their computers. Earlier, Chinese manipulation cards were added in to the Apple or IBM machines to make them 'Chinese Computers'. The bit-patterns of the Chinese characters are stored in the EPROMs on a card, and English-version application software is somewhat modified to give limited Chinese I/O capabilities to the system. Recently, these add-in cards have been replaced by diskettes with I/O drivers and Chinese character patterns.

A research project sponsored by the Industrial Development Bureau of the Ministry of Economic Affairs last year had identified the workstation as one of the most promising products for Taiwan's computer industry in the near future. Earlier this year Multitech, the top computer maker on the island, had demonstrated its prototype 32-bit CPU-based workstation, bringing the technological horizon of Taiwan up to a new era.

As the demand for PCs increases, local manufacturers are paying more and more attention to the lucrative peripheral market. 1985 was not a good year for the local FDD (floppy disk drive) makers, and exports of monitors decreased by 5 per cent in value. Exports of printers, however, enjoyed a 95 per cent increase in value, and manufacturers are optimistic for the future. (See Table 1).

The first six months of 1986, however, have produced a different picture for the export of peripherals. FDD exports are growing while printers decreased considerably. Taiwan has been famous for its monochrome monitors in the past years, and now corporate efforts are directed to the colour models.

Currently there are two HDD (hard disk drive) manufacturers in Taiwan. Cogito had been in this industry for quite a few years and released its 20Mb models recently, sales are reportedly quite good. Another HDD manufacturer, Tatung, one of the top home appliances makers, is now in full scale production on an OEM basis.

Add-on cards, such as RAM cards, color graphics cards, FDD controller cards, multifunction cards etc, together with other accessories, totalled a remarkable export revenue of $US256 million in 1985, an increase of 146 per cent over the previous year. In fact, there are a considerable number of add-on card makers on this island. They offer good quality products and welcome OEM orders.

(Shipment: 1,000 units Revenue : million US dollars)

	1984	1985		
	Revenue	Shipment	Revenue	Growth
Microcomputer	152.3	860.0	239.7	57%
Disk Drives	85.8	549.0	41.7	-51%
Printers	22.9	98.1	44.6	95%
Terminals	207.1	893.8	225.0	9%
Monitor	318.9	3110.1	302.5	-5%
Add-on cards, accessories, etc.	104.4	118.5	256.4	146%

Source : Market Intelligence Center, Institute for Information Industry

Table 1: ROC export of computer products (1985)

(Shipment: 1,000 units Revenue : million US dollars)

	First 6 months of 1985	First 6 months of 1986		
	Revenue	Shipment	Revenue	Growth
Microcomputer	101.9	325.2	151.4	49%
Disk Drives	21.7	302.4	25.6	18%
Printers	25.6	39.6	17.4	-32%
Terminals	115.2	639.7	148.3	29%
Color Monitor	60.4	449.7	96.4	60%
Monochrome Monitor	87.2	1531.7	112.1	29%
Add-on cards, accessories, etc.	98.3	--	194.3	98%

Source : Market Intelligence Center, Institute for Information Industry

Table 2: ROC export of computer products (First 6 months of 1986)

Sun Up Computer Company

Sun Up Computer Company established in 1983, produces IBM PC, PC/XT, PC/AT compatible systems, peripherals and add-on cards. The company's overall monthly production capacity of these various products is 8000 pieces per month.

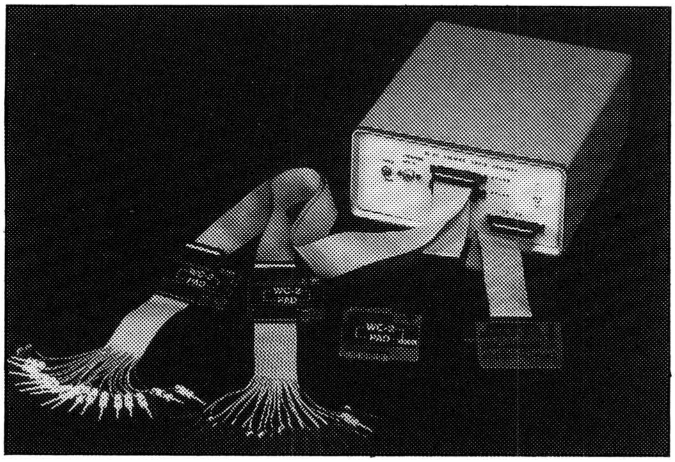
Sun Up employs some 60 personnel, all working to generate high quality products that can be offered at competitive prices.

The company's main export markets are found in West Germany, France, Italy, Australia, and South America. In 1985, the company had an average monthly export volume valued at NT$17,500,000. The monthly average targeted for 1986 is NT$30,000,000. Sun Up is also investing about NT$10 million for the construction of a new plant. Once that plant has come on line, production capacity is expected to move up to 10,000 pieces per month.

New products the company plans to be offering soon include a 100MHz Logic Analyser and modem cards. The ambitious expectations of the company's marketing personnel include sending experts to markets all over the world.

Sun Up enjoys technical cooperation with both American and French companies and expects that this will lead to a very prosperous future. The company's credo is 'Develop new products continuously," while the firm's management policy stresses strict quality control and dynamic management.

Sun Up Computer Company
No. 50, Lane 184,
Yung Chi Road
Taipei Taiwan ROC
Tel: (02) 763 0106-9
Telex: 24336 AMUNID
Fax: (886 2) 764 6301



Sun Up's new Logic Analyser

Horatian Enterprises

After accumulating almost 10 years experience, Horatian is now a specialist for producing computer connectors and a variety of cables. To keep competitive in the field and retain its good reputation, Horatian continuously makes efforts on research and development for improving products to meet customers demands of all kinds.

In view of the increasing orders, Horatian has just completed its new factory located in Hsin Tien which will give larger productivity.

Horatian connectors are world standard and can be connected with any brand's same series of connectors. In addition, there are three colours: blue, black and white in insulator available.

Horatian's cable products are UL approved, heavily shielded with braid and foil for EMI/RFI protection to block off the electro-magnetic wave inter-ference for over 90 per cent shelter rate.

Presently, Horatian's main markets are USA, European countries, Australia and South Africa. Horatian's goal is to expand its outlets to all over the world.

Horatian Enterprises
PO Box 7-458,
Taipei, Taiwan, ROC

Chino-Excel Technology Corporation

The Chino-Excel Technology Corporation is a member of the E-Hsin International Group, the largest trading company in Taiwan. CET is the electronic arm of E-Hsin and has just opened an Electronics Division to market products in that area.

CET currently operates from a three-storey factory in Chungho City. It manufactures semi-conductor chips for the local computer industry and assembles personal computers for the export market.

In 1985, CET had sales of NT$18 million after only two months of production. This year it expects to sell products worth NT$400 million. CET recently made an investment of US$500,000 in a silicon wafer manufacturing plant at the Hsinchu Science Based Industrial Park that will eventually cost US$5 million and manufacture products valued at US$8 million per year.

In the future, CET plans to produce a work station with CAD/CAM capabilities for PC layout to complement its work in IC design. It will probably feature the 68020 CPU and be suitable for office automation. CET is also working on projects that will utilise the VME bus and the Unix operating system. Eventually, CET will develop its own application system and produce new products in the PC board and IC design field.

Chino-Excel Technology Corporation
7th Floor,
61 Chung Shan N. Road,
Taipei, Taiwan, ROC
Tel: (02) 563 8652
Telex: 21540 EHSIN
Fax: (02) 531 3241

Key-State International Corporation

Established in April of 1982, Key-State International Corporation produces PCs and interface cards. With over 100 personnel, the company has a current monthly production capacity of 1000 PCs and 20000 interface cards. The range of these products extend through computer and telecommunications products and peripherals, including home computers, CAD systems and telecomputers.

David Song, the firm's CEO, explained that Key-State now exports to the United States (40 per cent), Europe (30 per cent), Australia (15 per cent), and other (15 per cent) countries. Key-State's total export volume last year was valued at US$600,000. The target for 1986 is YS$900,000. Key-State also plans to expand its

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production capability soon. The company will then have a monthly production capability soon. The company will then have a monthly production capability of 1500 PCs and 30000 interface cards.

On the company's planning board for new products are a Smart Baby AT and a Computerised Discharge Machine. In terms of marketing plans, the company hopes to soon be exporting regularly to South America and Australia.

Key-State currently has cooperation agreements with several foreign firms, among them, UNI-X Pty Ltd, Microhelp Computer, ACV Computer and Clean Computer.

Key-State International
Corporation
Tel: (02) 702 8320,
703 6422, 704 9740
Telex: 13299
Fax: (02) 702 2570

Microweb

Formed in 1983, Microweb specialises in the production of PC/XT and PC/AT portable computers. The company has a monthly production capacity of 1000 to 1500 units. The products range from custom designed to regular 16/32 bit units. Other items supplied by this company include motherboards and keyboards. Quality standards of the products extend from middle to high, while prices are kept at a middle range. Orders currently on hand will keep production lines busy through January of next year.

Microweb employs some 15 personnel and currently exports primarily to outlets in West Germany, the United States, Belgium, Austria and Switzerland. Sherman Tong is the firm's CEO.

Microweb is now undergoing expansion to raise production capacity. Auto soldering machines will be added to the company's production equipment and increased capacity after expansion should rise to 2000-3000 units monthly. The company also plans to start turning out LCD laptop computers and is looking to expand its marketing operations world-wide.

Microweb currently enjoys cooperation agreements with firms in the United States, West Germany and Portugal and has realised a strong need for further cooperation and better communication.

The company will be taking part in foreign trade fairs and exhibitions in the United States (November, 1986) Australia (March 1987), and West Germany (April 1987).

MICROWEB
No. 9, Lane 146, Sec.1,
Ta-Tung Road,
Hsichih, Taipei Shen
Taiwan, ROC
Tel: 643 1520 (3 lines)
PO Box 3-10 Hsichih
Taipei Shen
Telex: 32454 AUTOWEB
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TAIPEI

Sanwel-Comp Enterprises

Sanwel-Comp Enterprises was established in July, 1984, to produce IBM PC/XT, Turbo and PC/AT compatible computers and peripheral products. It generates a monthly output valued at NT$1 million. The company employs 30 personnel and the range of the company's product line extends from motherboards to small IC chips. All products conform to America's FCC Class B regulation standards. Prices of the company's broad range of products vary from US$15 to US$400. Orders currently on hand run through November.

Main export markets for the company are found in the United States and Australia. The firm's exports last year came to US$1.6 million and the target for this year is US$3 million. Market expansion plans to seek to enlarge US and Australian outlets and move into Europe. The company has NT$5 million for expansion investment and expects to increase monthly production volume to US$400,000 once the expansion has taken place.

For the future the company is looking into the production of other computer related items and hopes for marketing breakthroughs in Europe. It currently has cooperation agreements with US firms: KISS Computer Corporation and SCS Systems. The company will also become more active in local and foreign exhibition.

Comdek Industrial Corporation

Comdek Industrial Corporation specialises in the production of colour monitors, monochrome monitors, PC PC/XT, PC/AT interface cards and switching power supply units. The company has a monthly production capacity of 1000 units per month for its colour monitors, 8000 units per month for its monochrome monitors and 10,000 pieces per month for interface cards.

Comdek was established in March 1985 and employs 50 personnel. Its colour and monochrome display monitors and interface cards are all suitable for IBM compatibles. The firm's EGA colour monitors satisfy high quality, high resolution requirements. While these products are of high quality standard, they are priced very competitively. Orders currently on hand cover production through the next three months. Existing export markets are found in the USA, Canada and Europe. The firm has an export volume valued at US$3 million last year and has set a target of US$5 million for this year.

Comdek expects to invest another US$0.5 million to expand production capability and turn out more switching power supply units and PCs. Production capacity is expected to increase 20 per cent including modems, portable PCs, and multisync display colour monitors that can run from 15 to 31KHz of horizontal scanning. For a new marketing outlet, the company is now looking to Australia.

Comdek Industrial
Corporation
PO Box 30-115, Taipei,
Taiwan, ROC
Tel: (02) 396 4526
Telex: 13309 YUHYEANG
Attn: COMDEK

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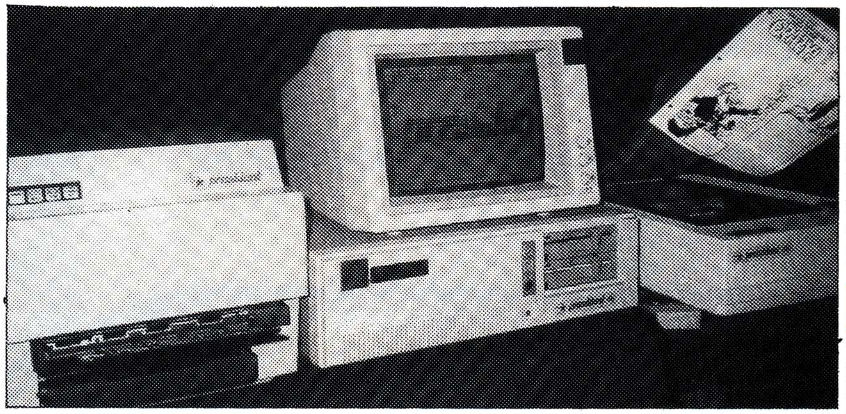

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WYSIWYG OR NOT

"What You See Is What You Get" is a term you will be familiar with when you use D.T.P., it means what's on the screen is what it prints but, with software that allows embedded commands or strings of instructions in your text editor and word processor to execute page formatting with text and graphics.

PAGE SCANNING

Up to now software was the major means of input into your D.T.P. system but there is limitations in software input.
To be able to place text, graphics, pictures, 3D objects onto a Flat Bed Scanner, allowing you to input that image onto your computer screen in 9 seconds maximum at 300 D.P.I. resolution ready to be manipulated in many ways and print out in 10 seconds is a long overdue requirement in D.T.P. Page scanning and is a MUST in a complete system. Not only is it an enormous time saver, scanning will open up a whole new field of applications.

SAVINGS:

In every type of organisation and business, printing is a major expense.
Printing is used in letterheads, company stationary and manuals, bulletins, newsletters, forms, advertising promotions to just name a few.
To be able to prepare your own artwork, finished art in medium sized runs, do your own printing, can mean an enormous cost saving that soon results in a profit from your investment.
Also, the ability to translate your own style in your own way, make changes and try different formats in your own office adds a new degree of speed and efficiency which you have never experienced before.
Your company cannot afford to be left behind in today's fast and competitive market place, new ideas and deadlines give you the boost to achieve improved results and a better company bottom line.

SYSTEM:

Because D.T.P. is made up of integrated units such as a computer, monitor, scanner, laser printer, and software to purchase the fully matched system from a single source has decided advantages. President offers a complete system, a matched system to give your company the support and confidence only a 16 year old Australian company can offer.
Computer and Scanner Australian Built.

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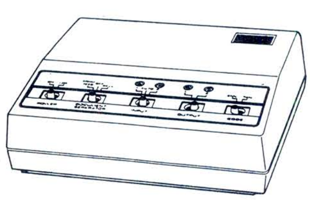

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- Pencil & pen feature to correct mistakes without reverse entries
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- CRT transaction inquiry, unlimited journals
- Activity report, trial balance, financial statements, etc.

Accounts Receivable
- Open invoice or balance forward
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- Unlimited # of customers
- Mailing labels and directories with 4 different sorts
- Automatic finance charges
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- 3 Year customer history for # of invoices, sales, costs, and profits
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- Cash flow analysis
- Sales analysis
- Automatic sales forecasting by customer, salesperson or customer type

Accounts Payable
- Cheque printing and up to 10 invoices paid per cheque
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- Vendor directories with sorting by vendor code, name, or territory
- Aging reports with 7 customized columns
- Unlimited # of vendors
- Mailing labels with 4 different sorts
- 3 Year vendor history for CRT inquiry and printing
- Flexible payment calendar
- Automatic forecasting of purchases
- Unlimited allocations per invoice

Inventory
- Supports average, last purchase, and standard costing methods
- Powerful physical inventory routines
- Accepts any unit of measure like fractions/dozens/gross/hours/minutes, etc.
- Automatic changing of costing methods
- Time and product inventory
- 3 Year product history in units, dollars, cost, and profits
- Automatic forecast of product sales
- Automatic pricing assignments
- Alert and activity reports with 11 sorts
- CRT shows on-hand/on-order/committed/sales/cost/profit/turns/GROI

Purchase Order
- Usable for inventory and non-inventory items
- Allows up to 99 lines per purchase order
- Per line discount in %
- Purchase Order accepts generic discounts/freight/taxes/insurance
- Purchase Order accepts back orders & returns
- Purchase journal
- Automatic interfacing with General Ledger, Payables, and Inventory

Billing
- Invoicing on plain or pre-printed forms
- Prints sales journal
- Automatic updating of committed products in inventory
- Ability to customize invoice for remarks
- Allows return credit memo
- Interfaces with Inventory, Accounts Receivable and General Ledger

Forecasting
- Unique program that automatically forecasts using your 3 year history
- Forecast revenue and expense accounts
- Forecast vendor purchases
- Forecast customer sales, cost, and profit by customer or salesperson
- Forecast inventory item usage by 4 automatic methods
- Forecast by same as last year, or % base from last year, or trend, or least square trend line anaysis method

Minimum Hardware Requirements:

IBM (PCjr, PC, XT or AT)[1] or other compatibles, 128K memory, one 5¼ DSDD floppy disk, 132 column printer or 80 column printer in compressed mode, 80x24 CRT, MS-DOS[2], PC DOS[1] 2.0 or later.

[1] Trademarks of International Business Machines. [2] Trademark of Microsoft Corporation.

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